

WHAT BUSINESS CAN DO ABOUT HAZARDOUS WASTE

HOW FOREIGN INVESTMENTS BENEFIT U.S.

TechnologyReview

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MONEY, POLITICS, AND THE B-1 BOMBER

WHY THE MILITARY PROGRAM IS
OUT OF CONTROL



technology review

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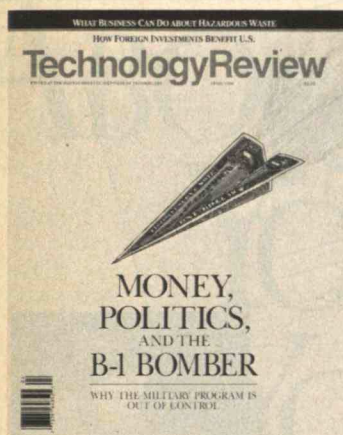
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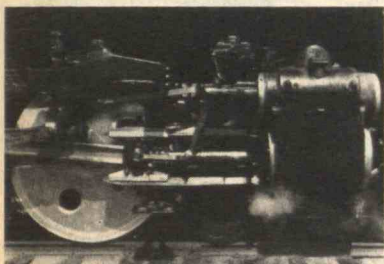
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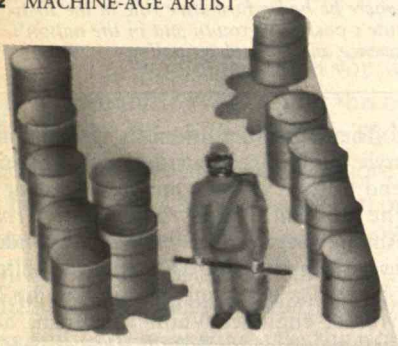
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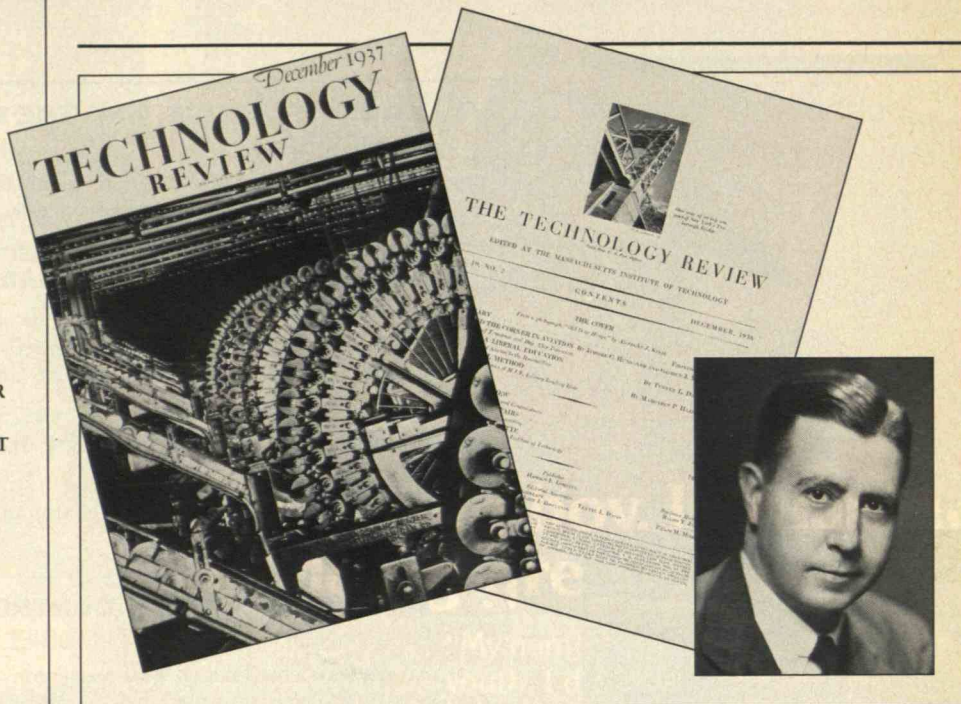
Frank Urbanowski

The M.I.T. Press

FIRST LINE

FROM THE EDITOR

An Illustrious Editor



FEW of today's *Review* readers have experienced the grace of word and image that characterized this magazine in the 1930s. But an appreciation of them is appropriate now, for they were the work of a young editor named James Rhyne Killian, Jr., who died at the age of 83 last January 29.

Killian's first employment after graduating in the "engineering option" of M.I.T.'s course in business and engineering administration in 1926 was at the *Review*. By 1930 he had become editor, the post he held until he joined the M.I.T. President's Office in 1939. Increasing responsibilities there culminated in his presidency of the Institute from 1948 to 1959, when he was asked by President Dwight D. Eisenhower to be the first White House science advisor.

Though we think of the 1930s as simpler days, many subjects then in the *Review* were prescient of issues today. There were articles on the hazards of occupational disease, roles for women in technology, science and the state, mobile homes as the model for prefabricated housing, how to build safer automobiles, how low temperatures reduce electrical resistance, and the interrelationship of machinery and unemployment. The *Review* of the 1930s was distinguished also by its style, displaying an elegance of typography and illustration that stands well the test of time.

As its editor, James R. Killian, Jr., brought distinction to *Technology Review* throughout the 1930s. Shortly after this portrait was made he entered the M.I.T. administration, where he had a formative role in the Institute's post-war growth and in the nation's science and technology policy.

These qualities of both intellect and style can be largely attributed to Killian—and to the experts who were brought to the *Review*'s pages by his initiative. Among regular contributors were industrial chemist Arthur D. Little; the editors of *Aviation* magazine; physicist Philip M. Morse, engineer Vannevar Bush, and mathematician Norbert Wiener of M.I.T.; and all three Compton brothers—Arthur, Karl, and Wilson. In his memoirs, Killian recalls consultations with such distinguished typographers as William A. Dwiggins and Daniel B. Updike, and artist/photographer Samuel V. Chamberlain had the title of editorial associate.

Even after 50 years, the staff is challenged by the vision and achievements of the magazine's most illustrious editor.

John I. Mattill

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Anxiety in the Sky

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FEAR OF FLYING

In "Aviation Safety: Fact or Fiction" (*August/September 1987, page 32*), Robert Reed Gray not only understates the shortage of trained aircraft maintenance personnel, but he also passes on an erroneous assumption when he suggests that there is such a thing as a "good basic training" for mechanics. The course of study in trade schools is highly specialized. Mechanics trained to work on diesel trucks cannot readily turn around and use their skills on jet engines. Nor can a sheet-metal mechanic trained to repair heating ducts immediately begin working on airframes.

An airframe and power-plant (A&P) mechanic's license requires two years of intensive classroom study or three years of documented work experience. An unlicensed mechanic hoping to obtain the on-the-job experience needed for certification would probably be hired as a cleaner or mechanic's helper and would start at minimum wage, or close to it. Considering that A&Ps are among the lowest-paid of the skilled trades today, it appears highly unlikely that any diesel mechanic would choose to forego working on trucks for \$20 an hour now for an opportunity to eventually earn \$5 an hour working on aircraft.

There is indeed an impending crisis in the quality of aircraft maintenance. The situation has been building for years as management cut mechanics' wages while telling them to be grateful for benefits like cheap travel. Increasing numbers of mechanics are realizing that inexpensive tickets aren't much good if you have no money to spend once you get off the plane. The pool of skilled, dependable, experienced A&Ps is shrinking as people retire or

change careers, and declining enrollments at many vocational schools indicate that the situation will get a lot worse before it gets better.

NANCY F. MANNIKKO
L'Anse, Mich.

The general public must share the blame for the air-safety problem, since people have violently opposed every new airport proposed in every major city in the country. In 1987 we are flying in the New York metropolitan area with the same number of airports we had in 1947. Imagine the pandemonium if we had had no improvements in highways in the last 40 years.

LOUIS J. CAPOZZOLI
Baton Rouge, La.

SDI FOIBLES

I appreciate the explanation Peter Clausen and Michael Brower have given for the shifts in military vision ("*The Confused Course of SDI*," *October 1987, page 60*). I find even more reasons for disquiet about our government's drive to put up a technological defense system in space heedless of cost and effectiveness.

Many of the dream systems for the strategic defense initiative (SDI) involve beams of great intensity aimed by preprogrammed mechanisms; others foresee projectiles with uncommonly high kinetic energy. What dangers do their testing or accidental triggering pose for us on the ground or in airplanes? The government and the military have no exemption from Murphy's Law.

A special source of apprehension is the possibility that SDI systems may take a notion to defend us against one of the missions of the space shuttle or, perhaps even more embarrassing, one of the much more numerous Soviet space-exploration efforts. If the "neutral-particle beam" reacts to its target's mass and nothing else, it might well be fatally confused by a vehicle lifting a Mars probe.

WAYLES BROWNE
Ithaca, N.Y.

I would go further than Clausen and Brower have and say that SDI is the wrong answer to population defense. A better way to do the job is to remove the threat. This is not a call to instant unilateral disarmament; it is a call to change the direction of our thinking. For example, we should cooperate with the Soviets on space exploration. Such an effort would save

both superpowers money, and it would create more openness between the two as well. The obvious first step would be to hire the Soviet Union to launch a commercial satellite for us.

JOHN D. FOGARTY
Columbia, Md.

RECYCLING MAGAZINES

Barbara Goldoftas's article "Cutting the Waste in Trash" (November/December 1987, page 28) is interesting and informative. But she fails to mention that many magazines are difficult to recycle. The clay coating that makes pages shiny and accounts for 60 percent of their weight ends up as sludge.

Technology Review should show its commitment to recycling by using paper with lower clay content. A popular British science magazine uses newsprint. This makes for easier reading (as there is less glare on the dull finish) and no doubt lowers production costs.

STEWART CORN
Eagan, Minn.

The Review's choice of paper is dictated in part by its concern for high-quality reproduction of photographs and drawings, which is not possible on newsprint. Economics are another factor—papers using recycled pulp being more expensive than those of virgin pulp.—Ed.

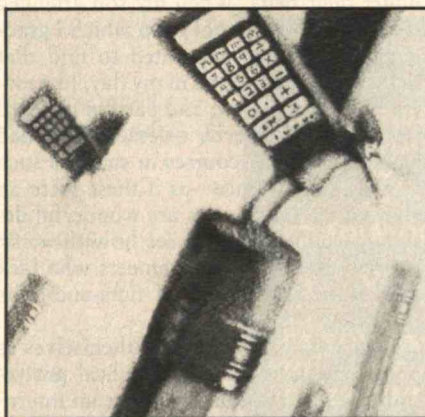
OPINIONATED COMPUTERS

As a software engineering auditor working on contract to the government, I applaud Bruce R. Herrick's courage in broaching the subject of computer-model abuse ("Curbing Abuses in Computer Modeling," October 1987, page 24). A few years ago I myself tried to debunk the first nuclear-winter model. Although it made no allowances for the effects of the earth's atmosphere, oceans, and ability to retain heat, the text and pictures released by the group doing the "research" showed continents and oceans, with clouds of dust and smoke spreading through the atmosphere. More recent models incorporating more parameters than the original "billiard ball in the shade" have reduced nuclear winter to nuclear overcast.

The violation of the public's trust by the nuclear winterists now makes it harder to work for the control and elimination of nuclear weapons. When the real conse-

quences of nuclear war are discussed, many people remember the fraud of the winterists and reject information necessary for a sane decision on nuclear arms. Part of the problem is that anti-nuclear activism became too heavily identified with winterism early on: those of us who criticized the original winterist model were accused of supporting the idea of fighting and winning a nuclear war. But the truth was that the winterists had reached a political decision first and then fudged the model to support it. I think that many of the questions surrounding the abuse of computer modeling can be understood in terms of political influences.

MICHAEL DUTTON
San Jose, Calif.



IN DEFENSE OF DRILL

I disagree with Anthony Ralston's argument that we should eliminate or delay arithmetic drill to make math studies more pleasant ("Let Them Use Calculators," August/September 1987, page 30). There is little doubt that arithmetic drill can be tiresome. However, good math teachers continue to drill only students who are having trouble. They might also reinforce drill by introducing the abacus, the slide rule, or the computer. Indeed, I believe that the abacus or the Japanese sorban, a similar device, should be an important part of elementary mathematics. And we should start work on story problems early rather than waiting until the child becomes secure in number operations. The shock of having to work with both words and numbers, instead of numbers alone, might thus be avoided.

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science, to say nothing of orderly thinking. Moreover, the statement that "being a good arithmetician is no longer necessary in daily life" is silly. Perhaps Ralston has never tried to straighten out a mistake in a supermarket cash-register slip while holding up a line of other customers. Arithmetic is needed for crafts, trades, commerce, science, and most self-teaching as well.

LOUIS A. WARNER
Woodbridge, Conn.



DOWN-TO-EARTH ENGINEERING

"Why We Need Hands-On Engineering Education" by Arnold Kerr and Byron Pipes (*October 1987, page 36*) is stimulating and provocative. But the suggestion that schools hire designers from industry as full-time faculty members raises several questions.

First, would these faculty be tenured? If so, who would evaluate them? Also, how much time should these people spend on design research—and how much on imparting the creative aspects of design to students? Finally, would these faculty receive salaries in the summer? Who might provide the funds for such salaries?

An alternative model that works very well at Duke University is to use adjunct faculty from industry. Of course, it does help to have a research park five miles from the campus and satellite manufacturing facilities all around the park. Admittedly, not everyone does. But if you do, it is a good solution to a tough challenge.

EARL H. DOWELL
Durham, N.C.

Earl H. Dowell is dean of the School of Engineering at Duke University.

"Why We Need Hands-On Engineering" attempts to compare our system of engineering education with that in other countries such as West Germany. But the authors fail to mention that German mechanical engineers must complete several years of training as mechanics before they can be engineers. In England, nobody can be an engineer without substantial machine-shop and drawing-board work.

It is an unfortunate fact that American engineering education is almost entirely dictated by inhabitants of the ivy-covered halls. As a result, the graduates of our institutions are generally useless in industry until they have a great deal of experience under their belts. When my son attended the engineering school from which I graduated, he was disappointed to find that many courses required in my day, like machine shop, foundry, and pattern making, were no longer even offered. They had been replaced by courses in subjects such as computer science—as if these were an alternative. Computers are wonderful design tools, but I fail to see how they can be used effectively by engineers who lack a basic understanding of nuts-and-bolts concerns.

Engineers like to think of themselves as professionals. But in the medical profession, candidates must complete an internship before they can practice. Law-school graduates must often start as clerks under the wing of a practicing attorney. Perhaps it is time to require some form of internship before college graduates can call themselves engineers. Otherwise, there may be some justification in classifying janitors as custodial engineers and garbage collectors as sanitation engineers.

G.W. DEAN
Plymouth, Mich.

Engineering educators who have given much thought to design education would agree with Kerr and Pipes. Student involvement in the design process is essential!

However, I demur from the implication that this is a new idea and strenuously object to the assumption that it is just beginning to be implemented at M.I.T. Mechanical engineering students have been involved in hands-on design projects over my total experience at the institute, which commenced in 1947 when I was a fresh-

man. My students at M.I.T. from the 1950s through the 1980s have researched, designed, and demonstrated air-to-air missile components that still fly; introduced computer-aided design; put neurally controlled artificial limbs into use; and provided blind people with computer braille translation and automatic embossing devices as well as ultrasound mobility aids. Over two score of the hundreds of my students have become hands-on teaching faculty in engineering design.

I also take issue with the authors' notion that industrial people can return to academia and be effective as design teachers. I have found that only the rare individual can transcend decades of experience working with other professionals designing particular products and become comfortable working with naive students over a wide spectrum of design endeavors. Moreover, design people in industry are usually far removed from the analytical and natural-law-based approach we expect our students to take.

ROBERT W. MANN
Cambridge, Mass.

Robert W. Mann is Whitaker Professor at M.I.T.; he was head of the Engineering Design Division from 1957 to 1966.

One point Kerr and Pipes have omitted is that any experienced designer who does decide to accept an academic position is practically starting a new career. Tenure committees consider primarily funded research and journal publications written while at the institution—and they virtually ignore design work and other efforts that do not result in publications. This makes recruiting and retaining experienced designers difficult.

DAVID ULLMAN
Corvallis, Oreg.

Kerr and Pipes seem to be confused about the role of the Accreditation Board for Engineering and Technology (ABET) in setting the standards for engineering accreditation. As ABET's accreditation director for over eight years, I reviewed the evaluation statements on every engineering program in the United States and recorded all the deliberations of the Engineering Accreditation Commission. Throughout that entire period design was unquestionably the major concern.

The authors are correct in noting that
Continued on page 26

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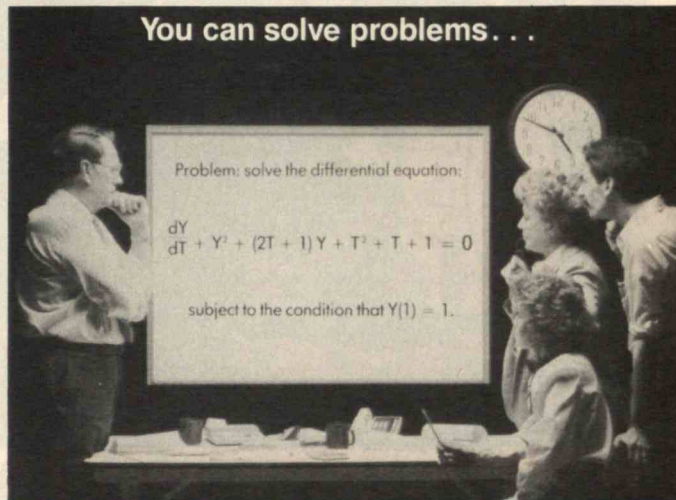
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(C3) SOLN:ODE(D2,Y,T);
(D3)  Y = - (%C T %E^T - T - 1) / (%C %E^T - 1)
(C4) SOLVE(SUBST([Y=1,T=1],D3),%C),NUMER;
(D4)  [%C = 0.5518192]
(C5) SPECIFIC SOLN:SUBST(D4,SOLN);
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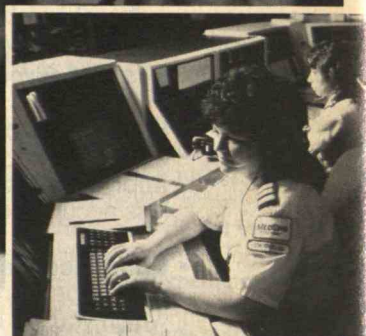
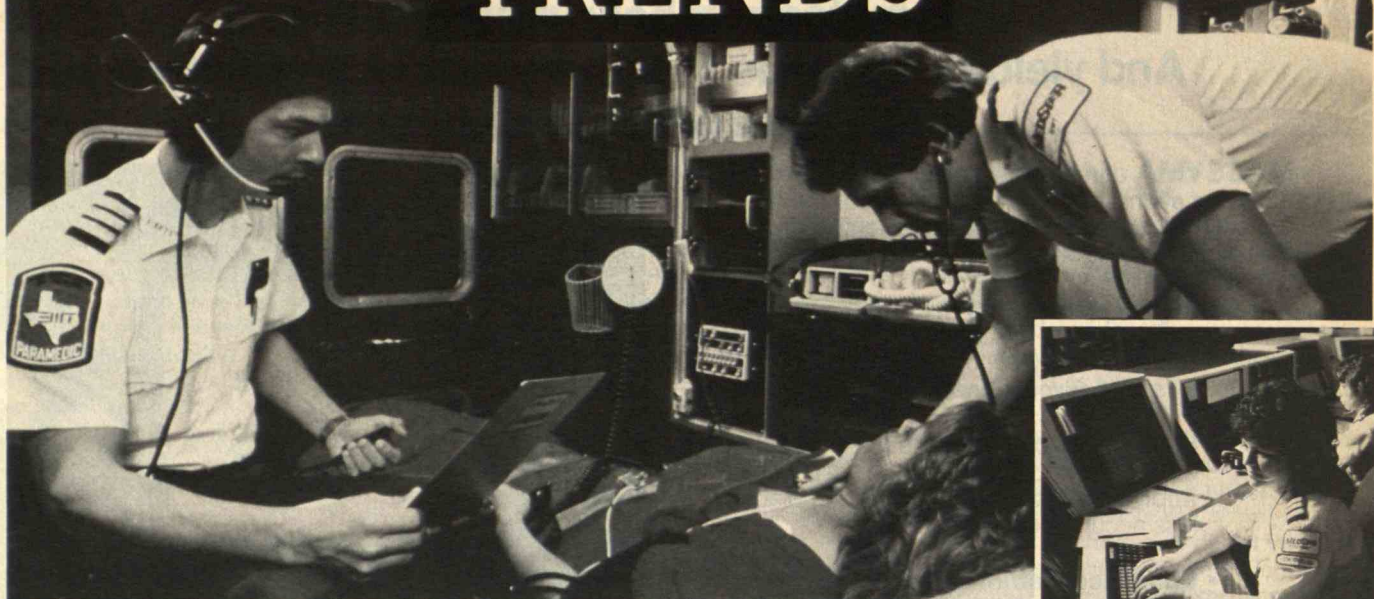
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The ambulance industry has undergone rapid change in the last 20 years. Before the Vietnam War, ambulances were basically "load-and-go" vehicles that rushed patients to hospitals, but battlefield medics showed that many lives could be saved if trained staff began emergency care immediately.

However, as the industry has progressed, emergency ambulance care has come to vary widely in both character and quality. In Ft. Worth, Tex., a private company has created a technologically dazzling service in close cooperation with the local medical community. Great Barrington, Mass., shares a volunteer service with surrounding towns. And in many Midwestern cities, fire or police departments respond to medical emergencies.

A community's size—and hence its tax base—explains many differences, but not all. The diversity is also the result of rapid technological change in the field of emergency medicine. A good number of cities and towns can improve ambulance service if they can balance hopes with budgets and other constraints.

At the high end of ambulance care are new "pre-hospital emergency vehicles." An ambulance fully equipped with advanced life support (ALS) technologies carries heart monitors, high-tech communications, intravenous fluids, defibrillators to shock a stopped heart into starting, and, if state regulations permit, paramedics qualified to administer drugs. Some physicians have even suggested that ALS ambulances carry video cameras so a doctor waiting in an emergency room could give advice.

All this costs money—up to \$75,000. To maintain the vehicle, insure it, and staff it 24 hours a day can require \$300,000 more each year. And technologies that are even more sophisticated will drive the price still higher. Ft. Worth recently purchased—for \$250,000—an advanced tracking system for its ambulance fleet. In Tulsa, Okla., computers link ambulance personnel to a mini-medical-records service. Other communities add helicopters to their fleet of emergency vehicles.

Small towns generally have the most limited options. "Few large private companies

will go into a small community," says Tracy Skeen, a vice president at Rural/Metro, Inc., a large Southwest-based private ambulance and fire-services company. Many communities have few, if any, ALS vehicles. They staff vehicles—usually operated through municipal fire or police departments—with emergency medical technicians (EMTs). Unlike paramedics, some EMTs can't administer drugs or read electrocardiograms.

Skeen says that emergency systems in these communities "could be enhanced with technology and funding for technology, but outside the big cities, some amenities can't be expected." However, he adds, "not all technologies are needed."

Financial barriers are not restricted to small towns. "Detroit has two paramedical units for the entire city," says Bob Forbuss, president of MedStar, the company behind the Ft. Worth system. "The rest is basic support."

Political Choices

In the hope of getting more for less, some communities turn to private companies like

Manufacturers call modern ambulances "mobile intensive-care units." The systems in some cities feature a single control center (inset).

MedStar and Rural/Metro. Forbuss's firm provides service to Las Vegas at no charge to the city. Patients get the bill, which health insurance often covers. On the other hand, Ft. Worth pays MedStar a \$1 million annual subsidy on top of what the company collects from patients. MedStar says its operational costs are higher in Ft. Worth, and more difficult to recover in fees.

Not all private companies offer premium service at low cost. Many within the industry readily admit that some private companies have "low balled" bids on ambulance service to win the opportunity to perform higher-profit hospital or nursing-home transfers. Sometimes these firms fail to deliver on emergency calls. And although quite a few towns are still required to pay for liability insurance, they may not realize it.

Bakersfield, Calif., which has a mix of public and private services, pooled its services with surrounding Kern

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Mt. Everest towers above one of the Tibetan plateaus that have attracted researchers from several disciplines. Icy water is only one of the perils of these unique labs.

County after a recent tragedy. In December, says city manager George Carvalho, a child died while waiting fourteen minutes for a private paramedic ambulance that backs up the fire department. Within days, city and county officials reached an agreement, and the council passed a resolution requiring ambulances to respond in no more than eight minutes.

Other communities have adopted financial and management strategies from the private sector, but have retained public control. They have separated ambulance from fire services, then beefed up equipment, hired paramedics, provided training, and even collected fees from patients' insurers.

Cost aside, communities reconsidering their ambulance service may encounter political barriers. About two-thirds of emergency calls in towns that are medium-sized or smaller in his state will be for an ambulance, estimates Bruce Alexander, assistant director of the office of emergency medical services in the Massachusetts Department of Public Health. This means a small-town fire department that loses its ambulance service may no longer be viable.

Whatever choices communities make, the gap between a Ft. Worth-style whistles-and-bells service and what many towns can provide will widen as the industry and the technology advance. "Some of the changes on the horizon are mind-boggling," Forbuss thinks. These range from more computers in ambulances to central-office monitors on which lights would pinpoint the location of all emergency vehicles. "We're an infant industry," he says. □

THOMAS KIELY is a frequent contributor to Trends.

Rooftop Laboratory



Imagine bouncing along in a jeep at 10 miles an hour 10 hours a day. After five days, you set up camp in the thin air at 17,000 feet above sea level. Next day, you climb 3,000 feet higher, work until dusk, then climb back down laden with rocks. At the end of three weeks, you load an 800-pound collection of rocks into the jeep and return home.

What could drive people to such extremes? The scientific secrets of Tibet. To geologists, meteorologists, anthropologists, and biologists, the "roof of the world" is a unique laboratory. This remote plateau—the result of a continental collision between India and central Asia that began 50 million years ago and continues today—is almost as big as Alaska and has an average elevation of 14,000 feet.

The laboratory was off-limits to Western scientists until a few years ago, when the Chinese government be-

gan encouraging collaboration between their scientists and those from the West. The Chinese now participate in several projects, providing people, equipment, and the know-how to get to the most remote areas of the plateau.

To those in the jeep—M.I.T. geologists Clark Burchfiel, Leigh Royden, and Kip Hodges—research in Tibet has suggested a novel idea. They believe that gravity limits how tall mountains can get, and that the Himalayas have reached that height. In the Himalayas, the researchers have found that some younger, higher rocks have moved down relative to older rocks. Further study has shown that the Himalayas persist in growing at the bottom, but gravity maintains the "equilibrium" height by collapsing them at the top.

Burchfiel says this theory gives scientists "a whole new way of looking at mountains." Geologists examining still-active mountains are now looking for signs of grav-

ity's influence, and those examining older mountains are reinterpreting what they see.

Observations in Tibet may also be significant for people living near major active faults. Of particular interest to Cal Tech seismologist Clarence Allen is China's Xianshuihe fault system, which lies just across the eastern border of Tibet. It "makes [California's] San Andreas look dead by comparison," he says. The geological features that allow researchers to reconstruct past fault movements are well preserved at the Xianshuihe, where human activity is minimal and the high altitude slows erosion.

Allen believes the geology of Tibet may help reveal how large an earthquake can occur at a given fault. One clue is "segmentation." Most faults



are split into several segments; the longer the segment, the larger the earthquake. Allen relates the magnitude of a recent earthquake to how Tibetans familiar with the landscape in past decades recall its pre-fault appearance.

Raining Mainly on the Plain

Insights from Tibet may improve weather predictions as well. In the summer of 1986, meteorologist Elmar Reiter of Colorado State University and a team of Chinese scientists determined that climatology textbooks "are blatantly wrong" about how much rain falls in the Tibetan high country. "They assume that the climate is the same as in the valleys, the only place where measurements were taken in the past."

Reiter found that a fair amount of moisture reaches the plateau, and that it is recycled. Within a half hour, precipitation may fall, evaporate, and fall again. He describes a constant ritual of donning and shedding his parka as the weather alternated between bitter cold hailstorm and warm sunshine.

According to Reiter, even the best global weather maps now "completely miss the boat every day over Tibet." The impact of that error is significant, since Tibet's weather has a "very pronounced influence" on the coming week's weather over the entire Northern Hemisphere.

For Case Western Reserve anthropologist Melvyn Goldstein, Tibet has shed light on a poorly understood way of life—that of the nomad. About a third of Tibet is inhabited only by nomads. Occupying grasslands 16,000 feet above sea level, they earn

their living by keeping herds of goats, sheep, and yak.

In several hundred interviews with Tibetan nomads, Goldstein found that "being a nomad is much different from what people thought." Tibetan nomads aren't the free-spirited wanderers portrayed in anthropological literature. They don't like to move around and, since someone owns every pasture, aimless wandering would lead to trespassing. However, Goldstein believes that Tibetan nomads are different from others because they have always lived under a stable government. Nomads elsewhere have spent much of their time fighting governments or warlords and moving to escape enemies.

Goldstein's colleague Cynthia Beall is interested in how Tibetan nomads have adapted to the low oxygen levels at high altitudes. The current view of physiological adaptation comes from studies of Andes Mountains Indians who have barrel-shaped chests, huge lungs, and high hemoglobin levels. Tibetan nomads, living thousands of feet higher, share none of these traits, although their hemoglobin is still significantly higher than that of sea-level dwellers.

It may be that there are different ways to adapt to rarified air. Goldstein and Beall are examining factors such as how frequently Tibetan nomads breathe, how much oxygen is present in their hemoglobin, and how effectively their tissues transfer oxygen. Goldstein suspects that this research will require scientists "to rewrite exactly how humans adapt to high altitudes." □

NANCY W. STAUFFER is a free-lance science writer and the editor at M.I.T.'s Energy Laboratory.

Robo-Soldiers

Jeffrey Moore, an engineer in Los Alamos National Laboratory's Advanced Weapons Technology Group, has a dream: to make U.S. military personnel safe from bullets, shrapnel, radiation, viruses, chemicals, and weather inside "thinking armor" that moves with its wearer. PITMAN, as Moore calls his "powered exoskeletal suit," would be equipped with controls that function like the nervous system.

Last spring, the army's Joint Services Small Arms Programs Office evaluated Moore's idea. No one at that office would go into detail about the conclusions, but Joel Goldman, chief of the

technology and support branch, says the super-high-tech carapace "could form a major part of a futuristic weapons system. We're looking at individual technology blocks, so we can marry command and control, ballistic protection, firepower, and life-support systems."

A report by Moore is more specific on applications. It postulates that "the survivability of PITMAN will give the Department of Defense an enhanced special-forces capability." Noting that public opinion severely limits "the military options now available for dealing with even Third World countries," the report says PITMAN's ability to reduce casualties could make interventions easier.

But promoting a suit for interventions could be controversial, and other obstacles hinder PITMAN's development as well. According to Moore, the main one is cost. He estimates that readying a prototype for testing would require \$8 million in the first year, with 20 to 25 percent increases per year for several years thereafter.

On the technological side, PITMAN's control system—its key component and "by far the most difficult technical issue"—is only theoretical. The suit could weigh 200 pounds even without weapons, but it must feel weightless. To be mobile enough for battles, it must move in tandem with the soldier's limbs instead of manipu-



The oil-covered sand in these bags will be treated with nitrogen-rich fertilizer to speed up natural decontamination.

lating them like a prosthetic device. And "force feedback," in which the exoskeleton responds to a soldier's pressure, is too slow and might be too tiring.

Moore feels that "the most elegant and flexible" control system would rely on magnetoencephalography (MEG), which measures tiny magnetic fields in the brain. PITMAN's MEG sensors would "read" the areas of the brain that command motion, detect planned movement, and then direct motors to synchronize the suit with the wearer's muscles. However, the sensors would require tremendous advances in superconductors, even beyond those predicted recently.

Moore admits he isn't a neuroscientist but thinks it would be possible to "isolate the parts of the brain dedicated to decisions and commands to use muscles." This has been done in a simple experiment using seven sensors. "To do the rest, we only need a large number of miniaturized sensors, which no one has developed because of the price tag."

Science Fiction?

The other aspects of PITMAN would be less exotic, although still on the far edge of available technology. The exoskeleton would be made of a strong, lightweight material, perhaps a graphite epoxy used in fishing rods and aircraft parts. Anchored to blast-proof boots, this framework would be treated with materials to ward off radiation. A backpack would hold an air conditioner, computer, and voice-activated weapons.

A fireproof Teflon-treated layer over the exoskeleton would repel bacterial and chemical threats. This layer would be coated with "stealth" materials to make

the soldier invisible to radar and heat-seeking weapons. Underneath the exoskeleton, a foam suit would cushion the wearer and buffer noise from the moving machinery. PITMAN's innermost layer, impregnated with antifungal and antibacterial agents, would be disposable.

Moore calculates that a PITMAN-clad soldier could remain in action for three days, "the army's standard limit to prevent battle fatigue." The armor might be less than comfortable, however. The soldier would survive on liquids supplied through a tube in the helmet, and Moore points out that for the three days "you can minimize the functioning of the large intestine with an anti-motility drug." For urination, he suggests a catheter. "The early astronauts stayed in their suits for up to two weeks."

The soldier would see the battle through a transparent screen, which would be made of material used in aircraft windows and coated to prevent blinding by laser weapons. An infrared system would provide a clear view at night and on smoky battlefields. Overhead, a display terminal, similar to those in fighter planes, would monitor the suit's systems and warn of enemies nearby.

While this personal, programmed suit might sound akin to Robocop, Moore protests: "I don't want to be associated with science fiction. Enough people think I'm far out." Still, for the time being PITMAN exists only as a "conceptual definition," although Moore is preparing a proposal for the army. He jokes, "They'll either fund me or commit me." □

ANN MARIE CUNNINGHAM is a free-lance writer specializing in defense issues. She is co-author of *Future Fire: Weapons for the Apocalypse* (Warner, 1983).



Beach Fertilizers

The next time an oil spill spreads its sticky goo across a pristine beach, environmental scientists may be seen running to the nearest farm supply store. Their aim: to buy lots of common, nitrogen-rich garden fertilizer.

After a decade of studying ways to clean oil-mucked beaches, researchers at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, have demonstrated that spreading fertilizer can dramatically boost nature's ability to break down petroleum. Recent tests at local beaches have shown that fertilizer compresses a yearlong decomposition process into a few months.

When oil washes up on beaches, it kills off plant and animal matter, providing a natural feast for bacteria. These microbes will feed on oil, but it's not their favorite food. "For [the microbes] almost anything is better than eating oil," says Eric Levy, a researcher with Bedford. The oil stays relatively untouched until the microbes finish gobbling up tastier foods.

Since fertilizer contains nitrogen, an essential foodstuff for bacteria, applying it triggers a population explosion—and the more microbes there are, the less time it takes for them to get around to eating the oil. In Levy's words, "After it eats all the beefsteak, it will go after the vegeta-

bles." The technique is relatively inexpensive, too: it costs the same as fertilizing a farm field.

Earlier attempts to clean up polluted beaches with fertilizer failed, but according to the Nova Scotia researchers, the reason is that the material wasn't given enough time to work: microbes take a few days to colonize the oil.

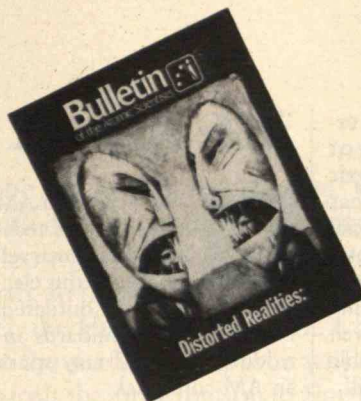
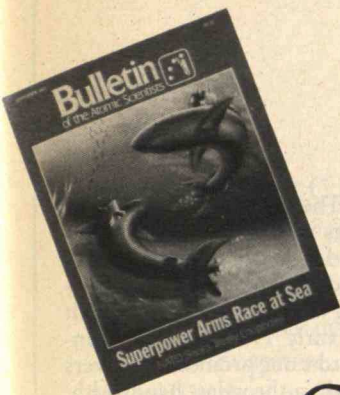
Nurturing Nature

One difficulty with the approach might be that it is *too* natural. Waves and seawater break down the fertilizer so that it must be reapplied every couple of weeks. Even so, Levy points out that from an ecological point of view fertilizing beaches compares favorably with traditional cleanup techniques in which sand is moved and buried. "Not only is this expensive but removing sand can create erosion," he says.

Levy adds that fertilizer would be an alternative to an expensive nutrient the French oil company Elf Aquitaine has developed to feed oil-eating microbes. The Elf product, an oily liquid called Inipol, has been used only in controlled experimental spills in Norway. It costs about 20 francs a kilogram in Europe.

Joseph Cummins, a University of Western Ontario geneticist on the board of Greenpeace Canada, says that although the fertilizer ap-

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“[Robert] McFarlane and Keyworth discussed the possibility that lasers might even be used to assassinate leaders like Muammar Qaddafi, a scheme that the science adviser said he dismissed as impractical, though not fanciful: ‘My God, if you want to do that, send a bullet,’ he told McFarlane.”

—“The Earthly Origins of Star Wars,” Gregg Herken, October 1987

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“Melvin McAfee...has cancer, his wife has thyroid cancer, and two of his four children have thyroid disease. He had just learned that thousands of curies of radioactive iodine had fallen on his and his neighbors’ farms since he settled [near the Hanford, Washington reactor] in the 1950s.

“A lot of the oldtimers have had cancers here. I’ve worried about Hanford a lot. They should have been more careful, and they should have warned us,’ he said.

“His son, Allan, was blunter. ‘I can’t trust Hanford. They’ve lied and covered up. I think they’re killing us,’ he said.”

—“Hanford’s Bitter Legacy,” Karen Dorn Steele, Jan./Feb. 1988

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proach appears sound, his organization would favor testing it for possible toxic side effects. Levy says this has not been done for financial reasons. However, he notes that since the bacteria break down known cancer-causing agents in oil, they might well diminish some of the possible deadly side effects of a spill.

Even more natural would be to spread manure on beaches. While Bedford researchers have not tested this, they suggest that it, too, would be an efficient source of nitrogen. Levy thinks some people might object to the smell, though.

The finding that fertilizer can efficiently clean up oil adds an ironic footnote to one of the most important legal precedents in the short history of U.S. biotechnology. In 1980, the U.S. Supreme Court ruled that University of Illinois researcher Ananda Chakrabarty could patent a "superbug" engineered to combine the oil-eating traits of five different naturally appearing microbes. This case was the first of several that established the patentability—and therefore the commercial viability—of bioengineered life forms.

But Chakrabarty has stopped work on the precedent-setting bug, and neither he nor General Electric, his employer at the time, have kept any. His later experiments showed that while his new organism can do a better job of cleaning up oil than any one of the five microbes that provide the genetic material for it, there is no reason to rush to market. When all five work in concert, as they do in nature, they are significantly more "super" than his superbug. □

STEPHEN STRAUSS is a science reporter for the Globe and Mail in Toronto.

AM: Almost Modern

Sixty years ago AM radio was a technological marvel, but today this electronic medium is outdated. However, two standards introduced in 1987 may spark an AM comeback.

AM's decline became noticeable in the mid-1970s when FM started to take over the market with its capacity for stereo and better fidelity. Since then, AM has lost over half its listeners to FM, falling from a 58 percent share of the market in 1976 to a 26 percent share 10 years later.

AM has been plagued by real technical deficiencies. For one thing, the AM dial is almost 20 times smaller in frequency space than the FM dial. Yet nearly every broadcast market has about as many AM stations as FM stations. The result is an overcrowded AM band, with stations generally spaced 10 kilohertz (kHz) apart. Since many stations broadcast the full 15 kHz range of high and low tones the human ear can detect, a good portion of the signals overlap.

To reduce this "splatter" interference, receiver manufacturers have produced AM radios that detect a band of frequencies only about 3 kHz wide for each station—less than one-fifth of the range of human hearing. To the listener, the effect is a noticeable absence of high-pitched sounds such as cymbals.

Another difficulty with AM signals is that because they are so similar to electronic noise generated by motors, computers, and other devices, they pick up a good deal of interference. FM receivers, with a different technology, are unaffected by such noise.

In 1985, these issues made their way into the National Radio Systems Committee (NRSC), which is sponsored by the Electronic Industries Association and the National Association of Broadcasters. NRSC members include radio-station owners and manufacturers of receivers and broadcast equipment. Ironically, they had originally formed the committee in 1981 to measure the performance of FM receivers.

The 1985 committee meetings were intended to reform AM at little additional cost and without rendering existing radios obsolete. The result in early 1987 was two standards: one promotes receivers with a broader bandwidth, and the other aims to reduce noise.

AM Hi-Fi

To allow manufacturers to design radios with a wider reception range, NRSC members agreed that stations should confine their signals to a 10 kHz bandwidth. Although the reform would do little for owners of old radios geared to receive 3 kHz, listeners to new AM radios would hear two-thirds of the human range.

To take advantage of this new standard, a radio station would need an additional circuit. The price could be as little as \$500, but the costs of

Radio stations like KRBC in Abilene, Tex., were a marvel in the 1930s, but since the mid-1970s AM has seemed out of date.



PHOTO: CROUSE KIMZEY CO.

Hughes Aircraft Company designed and built a probe for the Galileo Mission, which is expected to unlock the secrets of Jupiter, providing scientists with data about the planet's atmosphere. Scheduled for launch from the Space Shuttle in late 1989, Galileo will employ a solid-fueled Inertial Upper Stage rocket, aided by gravity assists from Venus and Earth, to boost itself from the Shuttle's orbit to the giant planet. Once Galileo is within reach of outer Jupiter, the Hughes-built probe will be released into the Jovian atmosphere. During its 60-minute descent to the surface, the probe will continually broadcast scientific data back to Galileo, which will then transmit the information to Earth.

Revolutionary "smart skins" will integrate avionics and sensors directly into the skin and structure of future aircraft and space vehicles. As part of the U.S. Air Force's Project Forecast II, Hughes is working with the USAF Avionics Laboratory to develop concepts and applications for a new generation of avionics. Systems using these technologies will provide levels of performance, reliability, and fault tolerance not possible in current conventional avionics systems.

A new circuit design complex will help Hughes microchip designers develop advanced radar and communications systems for military applications. The Microwave Monolithic Integrated Circuit (MMIC) Design Center will include cell libraries and computer-aided design workstations and will be located in the new gallium arsenide (GaAs) microchip production facility. Location of MMIC design and GaAs production in the same facility will benefit the design activities, as MMIC chip development requires repetitive design-processing cycles with quick turnaround. The MMIC program is designed to support all microwave and millimeter wave systems with the latest state-of-the-art technology.

A newly developed system significantly speeds up the measurement of digital data generated by modern radars. The Automated Radar Monitor (ARM) system uses a computer and special interface hardware. It replaces expensive, time-consuming manual special test equipment (STE) hardware panels currently used. ARM can collect high-speed digital radar data, analyze it, and display it on several computer terminals simultaneously. The cost of the ARM system, developed by Hughes, is approximately one-third that of the STE it replaces.

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KMEO in Phoenix, Ariz., is among the stations that are looking at new industry standards for bringing AM into the next decade.



manufacturing receivers—as high as four dollars each—would add up for companies such as Chrysler Corp., which makes over 2 million sets a year for its cars. The problem, says Chrysler engineer Jeff Reynolds, is the expense of components that widen the tuning range without compromising protection from interference. Fortunately, several firms are researching microprocessing technology that would eliminate the need for these components. In the interim, Delco and Chrysler sell 6 kHz receivers. By 1989, all Chrysler AM radios will be 6 kHz or better, says Reynolds.

The second NRSC standard, already used by FM stations, reduces the effect of extraneous noise, which generally interferes with higher frequencies. FM transmissions strengthen high frequencies so that a receiver can detect them more easily and reject most underlying noise. Then to keep the low tones from being drowned out, receivers de-emphasize the highs.

Most AM stations have also used this approach, but the lack of standards for em-

phasis and de-emphasis has limited its effectiveness. The second NRSC standard is for emphasis; as stations convert to it—for as little as ten dollars—radio manufacturers will introduce an inexpensive counterpart de-emphasis.

Of the approximately 5,000 AM stations in the United States, over 400 adopted the NRSC standards within 11 months. Marketing director Ray Updike of Circuit Research Lab, a manufacturer of broadcast conversions for both standards, says that already "1,200 stations plan to convert."

The standards were introduced as voluntary to make them available immediately and to keep revision from being delayed by the regulatory process. But since they have been accepted so rapidly, NRSC members have asked the Federal Communications Commission (FCC) to make the standards mandatory. If the FCC agrees, all stations would adopt them by the early 1990s. □

DEE McVICKER is a free-lance writer in Arizona and a sales engineer for a manufacturer of broadcast equipment.

MINI-TRENDS



PURE SPREAD

The Department of Agriculture may put peanut butter on TV to keep tabs on the specks that can lower the spread's quality. Currently, inspectors search for specks—usually the ground-up red skins of the nut—with the naked eye. But in an experimental system, a video camera scans peanut-butter samples. A computer divides the pictures into about 245,000 tiny squares, each of which is translated into one of 256 shades of gray. Squares with more specks appear darker, so computer-aided inspectors could grade the sample by counting squares that look black.

TOXICS AND RACE

Minority communities have more than their share of U.S. poisoned garbage, according to *Toxic Wastes and Race*. Prepared by the United Church of Christ, the new study covers all 415 operating commercial hazardous-waste facilities and all 18,000 "uncontrolled" (abandoned) sites.

Communities with multiple commercial operations were found to have more than three times the average proportion of minorities that

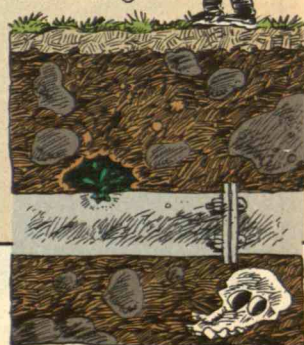
communities with no facilities have. In communities with one facility, the average minority percentage was twice as high as expected.

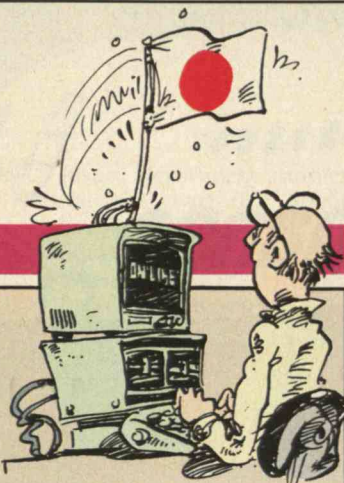
The study also says that three of the five largest commercial hazardous-waste landfills—accounting for 40 percent of the estimated U.S. landfill capacity—are in predominantly Black or Hispanic communities. And approximately half of all American Indians live near abandoned toxic wastes.

LEAK LISTENING

An electronic ear that can pinpoint leaks in underground pipes has been developed at Argonne National Laboratory. The acoustical sensor detects the sound of pressurized gas or liquid escaping from damaged sewer, gas, or oil lines. "Utility crews will now have more reliable and accurate information about the location of leaks before they start digging," says project physicist David Kupperman.

Two sensors on a pipe hear a leak and feed the information into a portable computer for analysis. The sounds indicate the leak's location





more precisely than do traditional methods, such as looking in manholes for vapor. Moreover, field tests in Scranton, Pa., have proven that the system can ignore outside noise.

BIOSAT COOP

More than 50 NASA-sponsored scientists are part of 27 major experiments using the Soviet biosatellite *Cosmos 1887*, launched in September. The cooperative effort is one of 16 projects under the U.S./U.S.S.R. Space Agreement signed last spring. The two nations have collaborated for more than a decade and a half in space biology and medicine, with the United States participating in five previous *Cosmos* missions. However, only a single U.S. experiment was on the last cooperative mission, in 1985.

JAPAN ON-LINE

Scientists and engineers in North America and Europe can now get the latest Japanese developments from a computer. The English-language database, produced by the Japan Information Center of Science and Technology (JICST), is available on the STN International scientific and technical information network. Since 1984, the network has tied the American Chemical Society's Chemical Abstracts Service to a similar database in West Germany. With JICST, the central facility for gathering and disseminating scientific and technical information in Japan, the system spans three continents.

The Japanese database contains summaries and other

information from more than 400,000 articles and technical reports published since 1985. About 18,000 summaries are added each month.

DOOMSDAY DELAY

The *Bulletin of the Atomic Scientists* has turned the hands of its "doomsday" clock back to six minutes before midnight. The clock, which indicates the trend toward or away from nuclear holocaust, first appeared on the *Bulletin* in 1947. It read seven minutes to midnight then, and has been reset 11 times since. The last change came in January 1984, when it was set at three minutes before midnight following an almost complete breakdown in U.S.-Soviet communications. The Soviets had downed a Korean jetliner, and the United States had deployed Euromissiles.

According to a *Bulletin* editorial, "The INF [intermediate nuclear forces] treaty, combined with improvements in U.S.-Soviet relations and greater international concern about common security matters, are significant first steps in a new direction." However, the editorial says that "these welcome developments sharpen our awareness of what remains to be done." It calls for a multilateral agreement on conventional forces in Europe, a comprehensive test ban, and deep reductions in strategic nuclear weapons.

Court Victory for Whistle-Blowers

A confrontation between the Nuclear Regulatory Commission (NRC) and a public-interest law firm has improved legal protections for nuclear-plant workers. NRC's defeat in court may also increase the flow of information needed to investigate plant safety.

NRC initiated the case against the Government Accountability Project (GAP), a clearinghouse and resource center for whistle-blowers who seek redress through the courts. NRC charged that GAP was withholding information the agency needed to protect public safety. But GAP attorneys say the incident underscores NRC's increasing tendency to accommodate the industry it oversees.

The dispute began early in 1987, when GAP attorney Billie Garde reported over 600 allegations of safety problems at the South Texas Nuclear Project to its operator, Houston Lighting and Power Co. (HL&P). Fifty-six workers—both HL&P and NRC employees—had contacted Garde with the allegations about the plant, which is scheduled to begin low-power testing by spring of 1988.

In response to Garde, HL&P asked for "every shred of information" GAP had collected. The utility also passed Garde's report to the NRC, which made the same demand for data. In a letter to GAP, NRC executive director of operations Victor Stello, Jr., noted, "NRC is the responsible federal agency for ensuring that safety-significant views are appropriately ad-

ressed." Both HL&P and the NRC wanted the informants' names.

In similar cases, GAP had reported safety allegations to the NRC. But the organization had gone to the utility this time because the workers distrusted the agency, saying its track record led them to believe they would be open to reprisals. They cited the example of NRC inspector Shannon Phillips, who had been directed to submit to psychological treatment and reassigned to a desk job. He had raised serious safety questions about Texas's Comanche Peak nuclear plant and charged that NRC managers, including Stello, were lax in enforcing safety. Stello later told the NRC's five commissioners that the psychological treatment was part of a counseling program to improve dissenters' interpersonal skills.

In another incident, George Mulley, Jr., an assistant director of NRC's office of inspector and auditor, claimed that the agency had made it "extremely difficult, if not impossible, to get any NRC employees or others to cooperate with ... ongoing investigations of Region IV management." He told a congressional committee last April that NRC top brass had removed statements of Region IV enforcement problems from a 3,000-page draft of a report before releasing a 47-page version to Congress. In the meantime, Stello had distributed the full draft throughout the NRC without notifying Mulley—and without editing it to protect whistle-blowers' identities. Mulley says that release destroyed



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"the rapport I had developed with these witnesses."

U.S. v GAP

In this context, says GAP attorney Richard Condit, South Texas workers "felt that what the NRC was offering them in protecting their livelihoods and careers was unacceptable." Garde and GAP devised a compromise: they would present the evidence to the NRC and arrange interviews with whistle-blowers if the agency would set up a special investigatory task force independent of Stello and Region IV officials.

The NRC had created similar panels to look into complaints at Region IV's Waterford and Comanche Peak plants, although those panels had not excluded Stello. While the NRC was considering the compromise, GAP turned over the substance of the allegations, withholding information that would reveal identities.

In a series of increasingly hostile exchanges between Garde and Stello, the NRC asserted its right to GAP's information, saying a special investigative unit and further guarantees of confidentiality were unnecessary. Garde refused to turn over names, citing an attorney-client relationship, and Stello rejected offers to negotiate. After a summer of legal quarreling, the Justice Department sued GAP on behalf of the NRC.

In the suit, the NRC insisted it adequately protected workers, that the information was legally the agency's, and that it needed the evidence to carry out its investigatory functions. Mark Nagle, the

Justice Department attorney, told the court that despite having "millions of pages of documents and numerous discussions with Houston Lighting and Power regarding safety concerns . . . we can't guarantee the NRC will know of Garde's clients' concerns."

Condit thinks that GAP and direct worker complaints had already given the NRC enough information to pursue the safety allegations. He says the NRC even knew the names of 17 GAP clients who, through the Department of Labor, had sued the agency. Condit believes NRC hoped the suit would intimidate GAP, but according to Nagle, "There is no merit to the charge that the NRC is trying

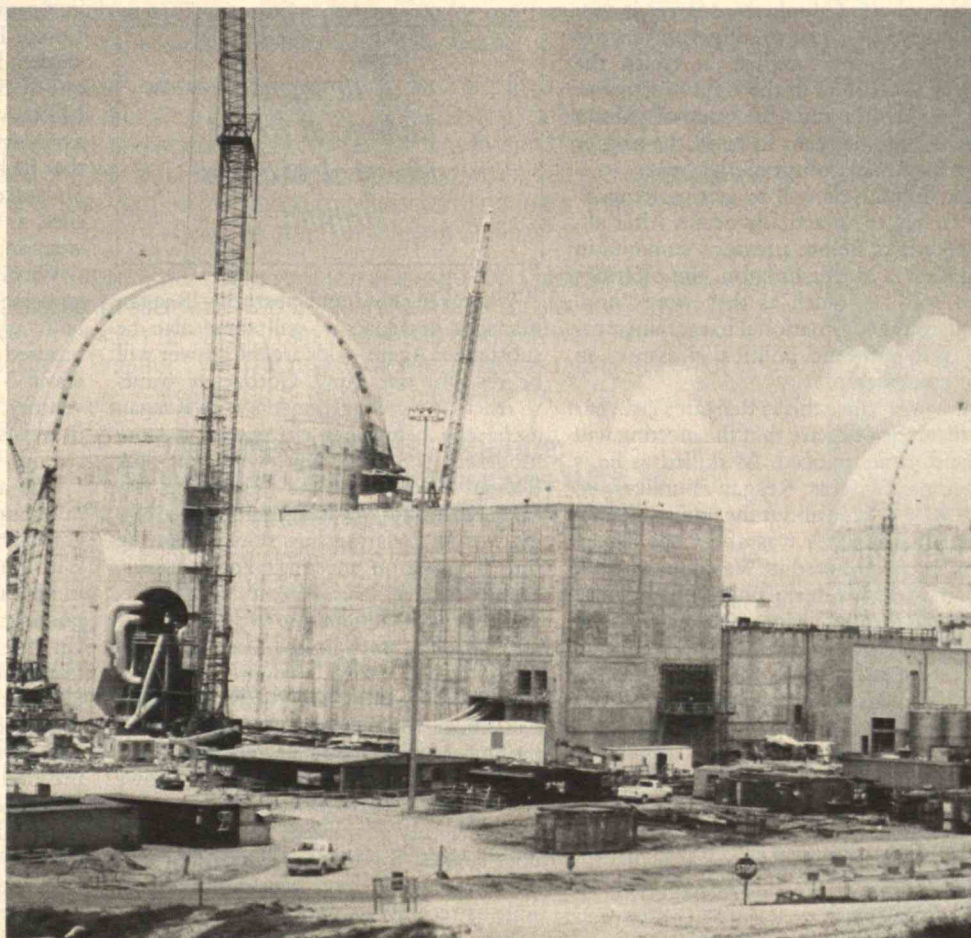
to destroy GAP."

On October 27, U.S. District Court Judge Thomas Hogan defended GAP's right to protect confidentiality and admonished the parties to find alternative ways to exchange information. "The NRC cannot cast with such a wide net when constitutional freedoms are at stake," he wrote.

Subsequent negotiations between the NRC and GAP are "going extremely well," says Jose Calvo, director of Region IV projects for NRC's Office of Nuclear Reactor Regulation. His team has reviewed the information from GAP and has begun on-site inspection of serious allegations.

The suit and similar charges of NRC bias toward the nuclear industry have led to at least five congressional proposals for reform. John Glenn (D-Ohio), chair of the Senate Governmental Affairs Committee, has offered a bill to create an independent inspector general for the agency. He says his committee "finds that current NRC operations . . . are deficient" regarding "the continuing controversy over the relative safety of commercial nuclear energy and the competence and effectiveness of the NRC in regulating that industry." □

CHRISTINE NICHOLS edits Power Line magazine for the Environmental Action Foundation.



The South Texas Nuclear Project could begin low-power tests soon, but workers have filed 600 allegations of safety problems there.

Summit Sequel: Reagan-Gorbachev IV

AFTER December's Washington summit extravaganza, some observers are predicting that the follow-up scheduled for Moscow in May or June will be an anticlimax. How can anything match the style, much less the substance, of the original?

There was Mikhail Gorbachev dominating our television screens—meeting with U.S. publishers and intellectuals, plunging into a surprised crowd to shake hands, haranguing the audience at his final press conference about human rights.

Beyond the hoopla, there was also the signing of the intermediate nuclear forces (INF) agreement. In an era where arms-control talks have always led to a buildup of arsenals, this pact commits both sides to the complete destruction of all their "shorter" (500 to 1,000 kilometers in range) and "medium-range" (1,000 to 5,500 kilometers) nuclear weapons.

Can we possibly top that this spring? On the whole, I think the answer is yes. Agreements between the superpowers are a bit like a solar eclipse in which the planets have to be in the right alignment. The personalities and the internal politics of both nations seem to be in the proper orbit for further progress this year.

The first hurdle will be getting Reagan-Gorbachev IV to actually occur. After all, in the weeks before previous summits in Reykjavik and Washington, the meetings were "off" as much as they were "on," owing to the international bargaining process and domestic political pressures in both countries.

However, since this is Reagan's last year in office, the odds are that the meeting will be held as announced. As skilled as he is before the cameras, Reagan is unlikely to be as well-briefed about the Soviets he will meet as Gorbachev was about the Americans he encountered in Washington. Still, the president wants the photo opportunity of riding through Moscow and working Soviet crowds—which in all likelihood will be as enthusiastic for him as Washington crowds were for Gorbachev, if not more so.



*The signs
look good for a
successful Moscow
summit.*

Whatever show and posturing Reagan manages in Moscow, will there also be substance? Again, odds are the answer will be yes. For one thing, Gorbachev wants to reach as many agreements with Reagan as he can before the election of a more moderate U.S. president, who will lack Reagan's clout with the right-wing. Another reason for optimism is the far-reaching working relationships achieved during the Washington meeting. For instance, Frank Carlucci, the secretary of defense, and Admiral William Crowe, head of the joint chiefs of staff, hosted Marshal Sergei Akhromeyev, Crowe's counterpart, at a discussion in the "tank"—the Pentagon conference room where plans to combat the Soviet Union are made. Presumably the Soviets will have to do the same for Crowe and Carlucci when they visit Moscow. Admittedly, this guarantees nothing, but it does suggest a working relationship that observers would have considered impossible as recently as two years ago.

Even more important are two aspects of the INF treaty with direct significance for

a possible agreement on both ICBMs (long-range missiles) and conventional weapons. The two sides have agreed to unprecedented verification procedures. Not only will there be on-site inspectors in places previously closed to foreigners, but each side has made public a complete inventory of missile sites.

The importance of this openness on the Soviet side is hard to overemphasize. Not too long ago at an arms-control meeting in Geneva, General Nikolai Ogarkov, then the senior Soviet military representative, complained to a U.S. negotiator that American estimates of Soviet military strength should not be discussed openly because the Soviet Union did not make that information available to its own civilian negotiators. This December, the Soviets were eager to publish such data, and it was the United States that hesitated.

Equally important was Gorbachev's implicit acknowledgement of an asymmetry in weapons inventory favoring the Soviet Union. The Soviets agreed to eliminate five warheads for every one that we destroy, and if there is to be further progress in Moscow, Gorbachev will have to agree to asymmetrical cuts once again. The fact that he has done so once bodes well for a 50 percent reduction in long-range missiles, as well as a cutback in conventional weaponry.

Why is Gorbachev so eager to sign these agreements and so willing to go more than halfway to get them? After all, the missiles banned in Washington constitute only about 3 percent of the Soviet missile inventory. And even a 50 percent cutback in ICBMs will not be much of an economic saving.

The answer is relatively simple. At a minimum, such arms agreements allow Gorbachev to tell his generals that there is no longer any need for further escalation in military expenditures. This will make it possible to cap the flow of the Soviet Union's best scientists, engineers, and artisans—not to mention badly needed supplies such as electronic components—away from the civilian sector.

Such a shift in resources is an absolute precondition for economic reform in the Soviet Union. That fact, more than anything, fuels the hope of achieving further superpower agreements, not only a 50 percent cutback in ICBMs and some curbing of conventional weapons but perhaps even a limitation on underground nuclear testing as well. □



MARSHALL I. GOLDMAN IS PROFESSOR OF ECONOMICS AT WELLESLEY COLLEGE AND ASSOCIATE DIRECTOR OF THE RUSSIAN RESEARCH CENTER AT HARVARD UNIVERSITY.

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An Engineer's Choices

THE historian Arnold Toynbee once remarked that, given the choice of any period of history and any society in which to live, he would select two. As a citizen and family man, Toynbee said, he would choose the Dutch Republic at the height of its glory in the 17th century. But as a historian, he would prefer to travel with Alexander the Great.

I haven't thought much about when or where I'd most like to live as a citizen and family man—although it certainly has been comforting to be a father *after* the discovery of antibiotics. But as an engineer—and, particularly, as an observer of engineering—nothing compares with having been born, as was I, in 1925. Perhaps it would have been nice to build aqueducts in ancient Rome or railroads in America during the 1860s, but I believe that the engineers of my generation have lived through a uniquely diverse span of years, and that our very special experiences tend to set us apart from engineers both younger and older.

The Dream of Engineering

I grew up during the Great Depression, a time when the salvation of humankind seemed to depend upon such mighty works as the dams of the TVA, and when the hope for the future was embodied in the General Motors Futurama exhibit of the 1939 New York World's Fair. It was a wonderful time in which to dream of becoming an engineer.

Toward the end of World War II, I served in the Seabees, the navy's construction corps. While I never saw combat, I was proud to work with those engineers and construction workers who coined the motto, "Can Do!" They combined technical ingenuity, personal valor, and noble purpose in an engineering enterprise that has seen no equal.

After the war, my contemporaries and I embarked on our civilian engineering careers at a moment in history when technology seemed to provide the answer to



*The lessons
of a lifetime in
one's chosen
profession.*

all problems, and when the prospect of nuclear power evoked talk of energy that would be "too cheap to meter."

But great changes were in the offing. Post-war euphoria gave way to what came to be called "the age of anxiety," and the engineering profession felt in full measure the change of mood. Public uneasiness was made manifest in a new and ominous symbol: the radioactive mushroom cloud. In spite of the fabulous achievements of engineers—space exploration, computers, lasers, and much more—members of the profession found themselves blamed for the nuclear arms race of the 1950s, vilified by the counterculture rebels of the 1960s, and called to account during the environmental crisis of the 1970s.

Along with other members of society, engineers were forced to re-evaluate many of their ideas about the nature of progress. For the first time in American history—and certainly in our own lives—we had to

consider the limitations of our natural resources and the fragile complexity of the ecosystem we all share. What's more, we could not help but see that the human spirit yearned for something different and better than an impersonal and over-engineered chrome and glass megalopolis.

Finding a Balance

Happily, in the 1980s we have seen the evolution of a more balanced attitude toward technology, consisting of both hope and caution, and tempering ambition with aesthetic and moral concern. Also, we have begun to see how closely our fortunes are intertwined with those of other lands, and how our technological efforts are affected by international competition and cooperation.

Having run the gamut from the naive enthusiasm of our youth to the chastened determination of our maturity, we find ourselves still active at a time when engineering has regained much of its former public esteem, indeed when engineering appears to be on the brink of a grand renaissance. A little younger and we would have missed the period during and immediately following World War II, a time that, for all our naivete about technology's promise, was thrilling to experience. A little older and we would have ended our careers while our profession was being widely denounced and our national confidence was at low ebb, and before we could bring to bear the lessons we learned during those years of travail.

I do not claim that we are wiser than our fellow engineers, junior or senior, or than other citizens of whatever calling or age. And I worry lest the caution we have learned be used as an excuse to dismiss the idealistic enthusiasm we look for in each younger generation and that seems so lacking in this time of political and economic conservatism. However, I do hope that, as a result of what we have experienced, we *are* wiser than our younger selves. We owe it to ourselves and to our fellows to share whatever insights we have gained in our journey through time.

So, unlike Toynbee, I have no predilection for ages past. All things considered—and considering all things is, after all, what the engineering method is all about—I'm happy to be a witness to my own time. □



SAMUEL C. FLORMAN, A CIVIL ENGINEER, IS THE AUTHOR OF *ENGINEERING AND THE LIBERAL ARTS*, *THE EXISTENTIAL PLEASURES OF ENGINEERING*, *BLAMING TECHNOLOGY*, AND *THE CIVILIZED ENGINEER*.

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New nuclear electric plants should be in planning *now*. But they are not, despite the fact that most Americans believe that nuclear energy is important and that we will need more.

Too many financial, political, licensing, and regulatory uncertainties stand in the way of America's being able to fully utilize its nuclear energy resources. For example, it has taken some plants as long as 12 years to be completed. If nothing changes, that means that a plant begun now might not be operating before the year 2000.

As America's economy continues to grow, America must find ways to keep pace with its growing electricity needs. Nuclear energy can play a major role in meeting those needs as well as keeping us less dependent on foreign oil.

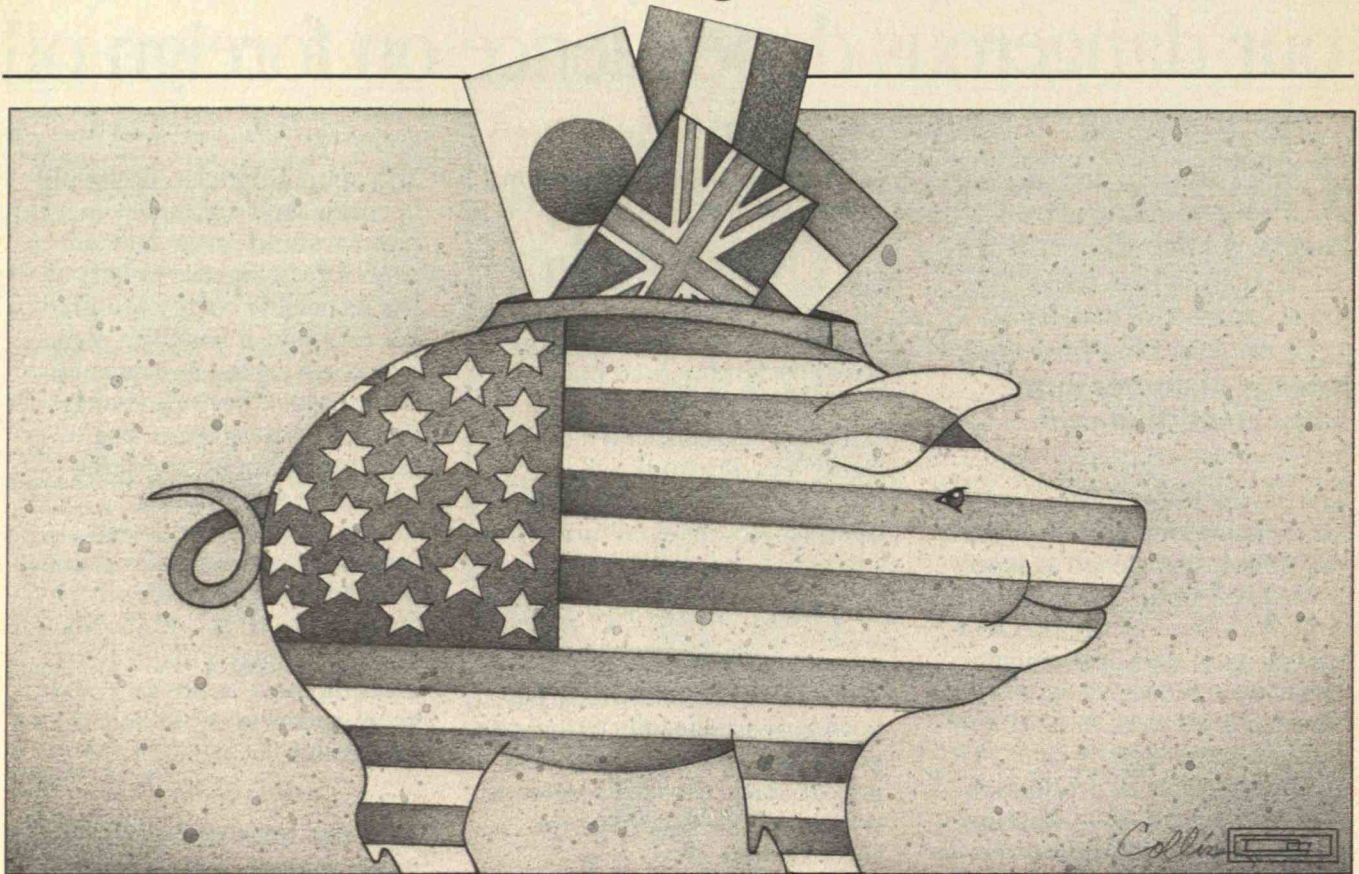
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BY RUDIGER W. DORNBUSCH

Welcome, Foreign Investors

JAPAN has already taken advantage of the open U.S. market to erode the American ability to compete in manufactured goods. Now foreign firms, the Japanese in the lead, are buying up American assets, ranging from banks and insurers to real-estate and manufacturing operations, at an unprecedented pace. They seem to be establishing a production beachhead in this country to reinforce their inroads, and to forestall the United States from keeping them out with tariffs and quotas. Will all Americans soon be reporting to Japanese managers and deans, and paying rent to Japanese landlords?

The pending U.S. trade bill includes an amendment requiring foreign firms to register and disclose their investment in the United States. The rule would affect foreign companies that own more than 5 percent of the assets of an American firm with gross sales of \$10 million or more, and foreigners who own more than 25 percent of a company with stakes in excess of \$20 million. Even if President Reagan vetoes the trade bill, as he has promised to do,

RUDIGER DORNBUSCH is the Ford International Professor of Economics at M.I.T.

***Foreign investment
in U.S. business could
bolster American
exports.***

the issue will come up repeatedly in the next 10 years. Many business and union leaders would like to see more drastic action to restrain foreign direct investment.

But such investment is strictly in the national interest. With this investment comes competition—and nothing is better for established, inefficient, and protected businesses. It is ironic that even as the U.S. business community is trying to open up Mexico and other developing countries to a fresh breeze of competition via direct investment, it laments taking the same medicine at home. But like other countries, we can benefit from foreign technology, management skills, and superior products. Foreign direct investment creates good jobs and benefits consumers.

The United States should not be concerned about foreign direct investment now. A number of facts prove my point:

□ This country remains the main international investor. Of the entire world stock of foreign direct investment, the United States commands nearly 40 percent, followed by the United Kingdom with 14 percent and Japan with less than 10 percent.

□ The total stock of foreign direct investment in the United States amounts to only 1.6 percent of American tangible assets. Of that stock, Japan has a relatively small share. Europe controls 68 percent, with the United Kingdom and the Netherlands each outranking Japan's portion of only 11 percent.

□ Of the more than 106 million people employed in the United States, only 3.2 million—3 percent—work for foreign firms.

Firms and workers who oppose foreign direct investment put forth a series of arguments similar to those heard in Europe in the 1960s, when American businesses were investing heavily there.

Labor and management first argue that as foreign companies displace domestic output, they reduce employment. The major reason is supposedly that foreign firms import components from their own factories or suppliers abroad to a much larger

extent than U.S. firms would. According to the *Wall Street Journal*, a United Automobile Workers study recently found that an American-owned auto assembly plant creates 25,000 jobs in U.S. supplier plants, while a typical Japanese assembly plant here creates only 6,700 jobs.

This argument is plausible when we think of firms entering the U.S. market to increase their share at the expense of American companies. But foreign investment halts job losses in industries already facing heavy competition from imports. While domestic companies may close down because of imports, foreigners setting up plants in the United States offer jobs. In a growing economy, a net increase in jobs may well emerge.

In any event, we need to be cautious about overstating differences between U.S. and foreign firms on the issue of importing components. American companies routinely market under their brand names goods produced abroad. And our automakers have discovered that Brazilian en-

gines help reduce model costs.

Another line of attack focuses on the unfair competition that foreign firms, especially those from Japan, are said to bring. They have access to a pool of low-cost capital that is not available to U.S. firms. But that is good news for the consumer who gains indirect access to cheap foreign factors of production.

Critics of foreign direct investment also focus on the fact that many industries, notably the automobile business, have excess capacity. If foreign companies create even more capacity, profitability will drop, especially for the least competitive. Reference to excess capacity calls on the regulatory instincts of our Washington bureaucrats. But why shouldn't Congress think of the situation as increased competition, which has a more positive ring, especially for the consumer?

Critics also ask what will happen if the foreign firms that do not have a commitment to the United States and its workers find their operations unprofitable. They

will simply pack up and return home, leaving behind the shattered lives of workers who placed their careers in the hands of these companies. Yet American companies increasingly move the production of components or entire products abroad and hence are much more suspect than newly arriving concerns. Indeed, foreigners often buy in where U.S. producers sell off.

Two further arguments, commonly made in Europe in the 1960s, have yet to reappear. The first is that foreign firms draw away labor and drive up its costs. It is true that Japanese financial institutions have raided the Federal Reserve, but otherwise such competition has not been an issue. Part of the reason may be that foreign firms have located in parts of the country such as Tennessee where labor is plentiful and relatively cheap.

The other argument is that foreign companies, borrowing in the U.S. market, drive up capital costs and crowd out the availability of finance for domestic firms.

Continued on page 78

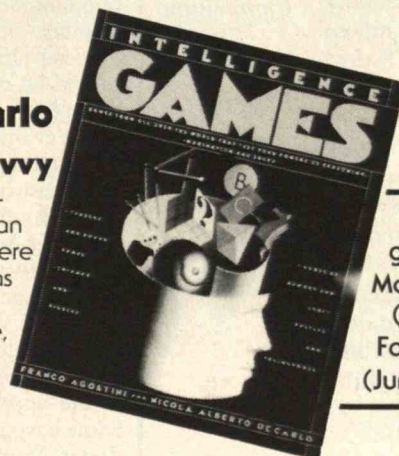
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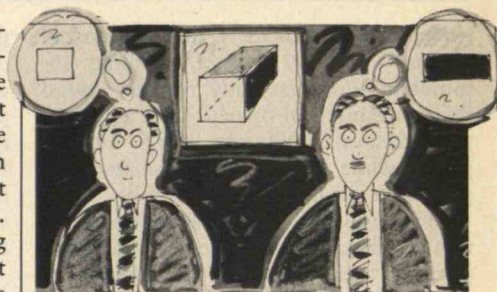
ABET requires students to take 12.5 percent of their total curriculum, or 16 semester hours, in engineering design. One of the reasons ABET finally specified credit hours in addition to percentages of the total was to allow institutions to enrich some elements of the curriculum without having to enrich all others in proportion.

The authors are incorrect in implying that ABET has not been concerned about the lack of actual design experience on the part of those teaching design; deficiencies in this regard have been cited forcefully in the accreditation statements to many institutions. However, it is the responsibility of the institution, not ABET, to ensure that faculty members are competent to teach the courses offered.

The main problem in enforcing design criteria has been the difficulty in distinguishing between engineering science and design. Experienced educators know that many subjects can be taught with either emphasis. ABET evaluators must rely heavily on a review of student work to determine whether design credits claimed by the institution are justified. Differences of opinion between evaluators and faculty members inevitably crop up when trying to determine what fraction of a course should be counted as design credit. Yet I can recall only a handful of instances where evaluators thought a school was undercounting its design credits.

Because of the recurring arguments over "bean counting," the leaders of the Engineering Accreditation Commission have tried to focus more on the quality of the design experience than on what fraction of courses should be credited. One significant development has been that ABET now requires an integrative design course in the upper division of the curriculum. Some have suggested that this "capstone" design-course requirement be strengthened while the separate credit-hour requirements for engineering science and design be reduced (the total number of credits would remain the same). Some trade-off between engineering science and design would be allowed in the organization of specific programs. This kind of approach, which has been used with some success by ABET's counterpart in Canada, would offer advantages in specialized curricula such as biomedical engineering, engineering science, and engineering management, where a heavier emphasis on science is desirable.

JOHN D. ALDEN
Pleasantville, N.Y.



PREJUDICE AND PEER REVIEW

In "Failing to Recognize Bias in Science" (November/December, page 26), Daniel Goleman suggests that peer reviewers may be subject to self-deception. I think a step in the right direction would be to reform the peer-review process itself.

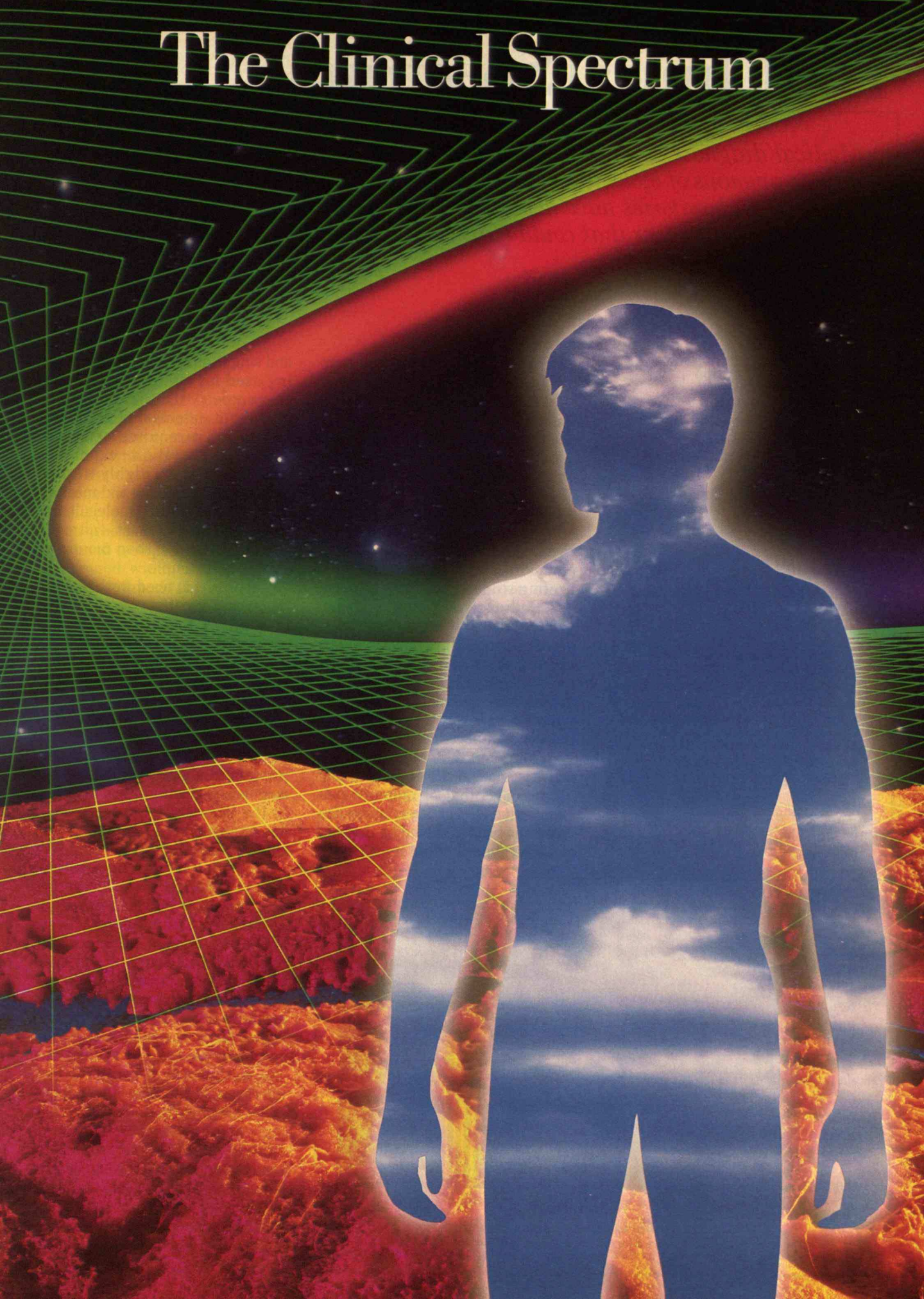
A key innovation would be to have a scientific journal publish a short "discourse on method" every few years. This would say what methods of scientific investigation the journal currently found acceptable. Reviewers would be asked to use only those criteria in evaluating papers, although comments regarding possible new ones could be included as well. Reviewers who continued to use idiosyncratic criteria would not continue to participate in the peer-review process, and records of reviewers' comments would be analyzed to see what criteria worked and what new criteria might be useful. Thus at any given time the methodological "rules of the game" would be definite enough for the stable operation of the process but fluid enough to evolve along with the scientific enterprise.

Some critics might consider such reform a kind of censorship, but it isn't: there are thousands of academic journals, and if the methods used for a particular study weren't acceptable to one journal, many viable alternatives would exist. Also, new criteria for judging articles could be used, but not post hoc and not without public review.

Implementing changes in the peer-review process would be difficult, of course. However, any problems could be resolved in "constitutional conventions" at the meetings of academic societies. In fact, if the history of politics is a guide, these mini-conventions would probably be lively and conducive to serious thought about the fundamental operations of science.

ARTHUR E. STAMPS III
San Francisco, Calif.

The Clinical Spectrum



The Clinical Spectrum

Medical diagnoses sometimes depend on the ability to trace or detect minute amounts of biological species. Now researchers at the General Motors Research Laboratories have developed a method of spectrometry using a tunable diode laser that could lead to simpler, less costly, non-invasive diagnostic techniques.

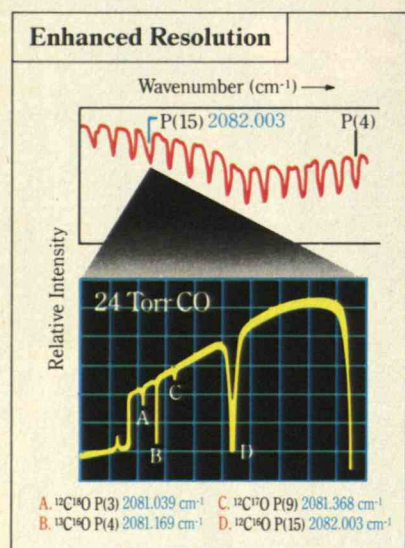
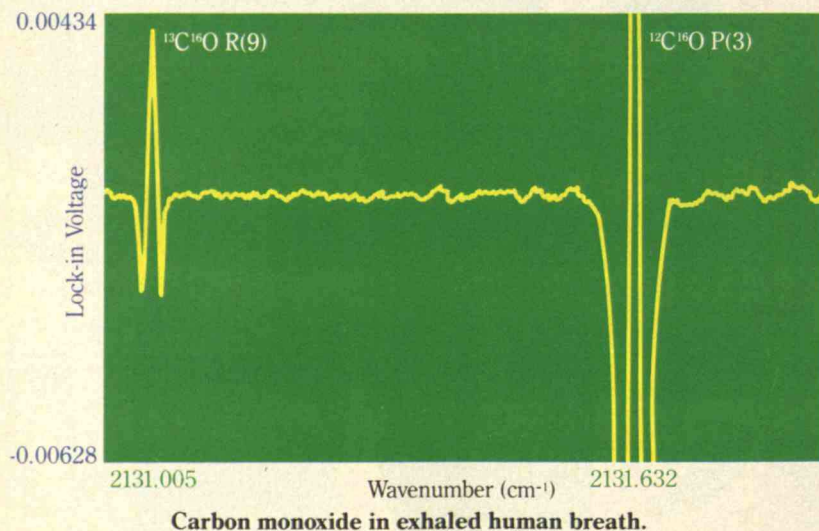


Figure 1: (Top) The absorption spectrum of CO obtained with a conventional spectrometer showing the P series rotation-vibration transitions separated by about 4 cm^{-1} . (Bottom) The diode laser spectrum centered at $^{12}\text{C}^{16}\text{O}$ P(15) region showing the complete resolution of $^{12}\text{C}^{17}\text{O}$ P(9), $^{12}\text{C}^{18}\text{O}$ P(3) and $^{13}\text{C}^{16}\text{O}$ P(4) transitions.

Figure 2: The second harmonic detection of the $^{13}\text{C}^{16}\text{O}$ and $^{12}\text{C}^{16}\text{O}$ as naturally present in exhaled human breath.



The scale has been expanded to show the excellent signal-to-noise ratio for $^{13}\text{C}^{16}\text{O}$. Other than removal of water vapor, no specific sample preparation or separation was needed.

In the process of living and growing, the body routinely takes in chemicals in the air we breathe and the food we eat, uses them, and converts them into other chemicals. These chemical activities, therefore, are often very good indicators of the health of the body or of its individual systems. The detection and measurement of particular chemical species is also of value in environmental, scientific and engineering studies.

Radioactive isotopes of elements in these chemicals have been extensively used as tracers. Many investigations, however, preclude their use either because no suitable radioisotope is available, or because radiation exposure raises health or environmental concerns.

The use of stable, non-radioactive isotopes for detection and tracing predates that of radioisotopes. But routine application of stable isotopes has been hindered by the lack of a detection method as versatile

and simple as the scintillation counting used for radioisotopes. Mass spectrometry is the traditional method of detection of stable isotopes, but it requires extensive sample preparation, expensive equipment, and a highly trained operator to distinguish and measure chemically different molecules of the same nominal mass—nitrogen gas $^{14}\text{N}^{14}\text{N}$ and carbon monoxide $^{12}\text{C}^{16}\text{O}$, for example.

It was this need for high resolution and greater versatility that prompted Dr. Peter S. Lee and Richard F. Majkowski to develop a system for stable isotopic tracer analysis based on the molecular absorption of infrared light. A tunable, single-mode diode laser, developed originally by the Physics Department of the General Motors Research Laboratories to measure automobile exhaust gases, was used as the IR emitting source in what has proved to be a remarkably sensitive spectrometer.

The infrared absorption spectrum of molecules normally consists of transitions between series of vibration-rotation energy levels. When an atom in a molecule is replaced by an isotope of the same element, there is a shift in the energy levels due to a change in mass. The resulting frequency shift in the transitions forms the basis of the laser spectroscopic analysis system.

In the case of carbon monoxide, for example, there are six possible forms of the molecule involving stable isotopes: $^{12}\text{C}^{16}\text{O}$, $^{12}\text{C}^{17}\text{O}$, $^{12}\text{C}^{18}\text{O}$, $^{13}\text{C}^{16}\text{O}$, $^{13}\text{C}^{17}\text{O}$, and $^{13}\text{C}^{18}\text{O}$. Consequently, there would be six sets of overlapping spectral lines. Within a region of 1 cm^{-1} , there can be lines from several isotopic molecules, with as little as 0.1 cm^{-1} or

less between adjacent lines.

This adjacency presents no problem for a diode laser system. The spectral resolution (the laser linewidth) is typically better than 10^{-4} cm^{-1} , which is orders of magnitude less than the isotopic line spacings. Since the diode laser is tunable, it can be centered in a region where the absorption lines of several isotopic molecules can be scanned within a single longitudinal laser mode (Figure 1).

In the initial experimental system, the source of the monochromatic IR radiation was a diode laser, made out of a single crystal containing layers of doped lead telluride and a lead-europium-selenium-telluride alloy. The IR light was collimated through a cell containing the sample to be studied and then focused onto an IR detector.

The cell was designed to have two optical path lengths that can be varied so that isotopic molecules with vastly different abundances can be determined from the measurement of the incident and transmitted laser intensities. U.S. Patent 4,684,805 covers this spectroscopic detection system.

The laser system can be made extremely sensitive using wavelength modulation and harmonic detection. Figure 2 shows the detection of $^{13}\text{C}^{16}\text{O}$ in exhaled human breath, where $^{13}\text{C}^{16}\text{O}$ is naturally present at a typical level of 1 to 10 parts per 100 million.

The present system can be used to measure stable oxygen isotopes in biological and organic samples that can be converted into CO . However, the method is applicable to any sample that can be converted

into a gas with a suitable IR absorption spectrum.

"The use of radioisotopes as tracers is already well established," says Dr. Lee. "The potential is just as great for stable isotopes if more versatile analytical methods are made readily accessible.

"Packaged as a simpler, relatively inexpensive instrument, a tunable laser IR system could be adapted to many clinical tests—for fat malabsorption, ileal dysfunction, small-intestine bacterial overgrowth, alcoholic cirrhosis and liver function, lung function, nutritional assessment, and diabetes, to name a few.

"Diabetes could be diagnosed from the lung exhalate of a subject who had been fed a stable isotopically tagged sugar sample. No taking blood, no long waits, no radiation health and safety concerns.

"Simpler isotopic tracer measurements could broaden the scope of tracer methodologies, could supplement some of the radioisotope studies now common, and could have significant economic implications."

General Motors



THE MEN BEHIND THE WORK



Dr. Peter S. Lee (right) is a Senior Staff Research Scientist in the Biomedical Science Department at the General Motors Research Laboratories. He received his undergraduate degree in Chemistry from the National Taiwan University. Dr. Lee also holds a Ph.D. in Physical Chemistry from the University of Illinois at Urbana-Champaign. His current research interests at GMRL include the study of biosensors and laser spectroscopy along with his work in stable isotopes. Dr. Lee came to GM in 1977 from the University of Illinois Medical Center in Chicago.

Richard F. Majkowski was, at the time of the work described here, a Staff Research Scientist in the GMRL Physics Department. Both his B.S. and M.S. degrees are from the University of Detroit in Physics and Mathematics. His research interests have included emission spectroscopy, coherent optics, holography and laser spectroscopy. Dick joined General Motors Research Laboratories in 1955 and retired in September, 1987, to become a Professor of Physics at Lawrence Institute of Technology.



*What drives the
U.S. defense establishment to champion various
weapons or strategies often has
little to do with their
military merit.*

MONEY, POLITICS, AND THE B-1 BOMBER

WHY THE MILITARY PROGRAM IS
OUT OF CONTROL

ON October 1, 1986, the U.S. Air Force proudly hailed a victory for which it had fought 30 years: a strategic bomber called the B-1 was taking its place in the American nuclear arsenal. The first squadron of 15 planes stood poised for action at an air base in the mesquite-covered hills of north Texas. Over the next 16 months, 85 more B-1s would roll off Rockwell International's production lines in the desert near Palmdale, Calif. At a cost of more than \$28 billion for the 100-plane force, the B-1 would be the most expensive airplane in aviation history.

The air force thinks the bombers are worth every cent. But some defense analysts have labeled the bomber the Flying Edsel, alluding to the highly touted 1950s Ford car that flopped. This controversy and others about the

*Special
interests have grossly
distorted defense priorities
and needlessly exacerbated
the arms race.*

bomber have swept over vast areas of the political and economic landscape. From Dwight Eisenhower to Ronald Reagan, seven presidents have faced key decisions affecting the fate of the B-1 and its experimental predecessor, the B-70. Often clashing with the incumbent president, Congress has acted on the bomber during each of the past 30 years, and the project has been started and stopped half a dozen times. Hanging in the balance have been huge economic benefits—for defense contractors, for labor unions, and for communities where the bombers would be built or based. At stake have been tens of thousands of jobs and contracts with 5,200 companies in 48 states.

The tangled and controversial history of the bomber leads straight to the heart of defense politics. The story reveals how national defense programs have been buffeted back and forth over the years—not only by an evolving Soviet threat, but also by myriad special interests competing in the political and economic maelstrom of American democracy. These special interests have grossly distorted defense priorities and needlessly exacerbated the arms race.

Throughout this checkered history, the air force and its allies in science, industry, labor, and politics have relentlessly pursued their goals—and other groups have opposed them. On both sides, the motives of patriotism, financial gain, career ambition, political aggrandizement, and loyalty to an institution or idea have often been so mixed that it is hard to tell what was narrow self-interest and what was concern for the national good. American leaders have been faced with the perplexing challenge of sorting out the conflicting interests and charting a path that would assure the nation's defense without squandering national resources or further inflaming the arms race. The challenge has not been met.

Four presidents—Eisenhower, Kennedy, Johnson, and Carter—considered blocking the development of a new strategic bomber. Jimmy Carter was the

last, and he thought he had killed the plane. The story of how pressure from military contractors, the military, Congress, and even Carter's own appointees saved the B-1 reveals the forces that have distorted U.S. defense policy.

The Politics of a Nuclear Engineer

President Jimmy Carter took office on January 20, 1977, pledging dramatic changes in American defense and foreign policy. He would seek peace, arms control, and the advancement of human rights, rather than further the defense buildup and confrontation with the Soviet Union: "We will move this year a step closer towards our ultimate goal—the elimination of all nuclear weapons from this earth."

Carter's first acts signaled the seriousness of his idealism. On his second day in office, he tried to close a bitter chapter in U.S. history by granting amnesty to Vietnam draft evaders. He proposed to the Soviet Union deep cuts in strategic arms. He appointed to key positions people dedicated to arms control, including Cyrus Vance as secretary of state. In his first meeting with the Joint Chiefs of Staff, the president shocked the generals and admirals by asking what would be required to reduce the U.S. strategic deterrent from nearly 10,000 missile warheads to a "minimum deterrent" of several hundred.

On January 31, Carter further stunned his advisors on defense, foreign policy, and the budget at a marathon White House meeting. During the campaign he had promised to cut defense spending by \$5 billion to \$7 billion. Irritated by a brief Defense Department memorandum suggesting that only \$3 billion could be cut from the next year's budget, the president spent seven hours of meeting time delving into the most minute details of 43 different defense programs. When the meeting ended near midnight, the weary officials realized that Carter, unlike his recent predecessors, meant to immerse himself in the most technical details of national defense.

But the first item—the B-1 bomber—had been dealt with quickly. No other item on the defense budget offered a bigger opportunity for savings. The president ordered Defense Secretary Harold Brown to reexamine the need for the bomber, and deferred action until the spring.

Copyright © 1988 by Nick Kotz. A Pulitzer-prize-winning journalist, NICK KOTZ has worked for the Washington Post and other newspapers. His study of military leadership won the National Magazine Award for public service and he is the author of four books, including *Let Them Eat Promises*. This article is excerpted from his book *Wild, Blue, Yonder: Money, Politics, and the B-1 Bomber* (Pantheon, 1988).



In June, Carter retired to Camp David for the weekend with a two-inch-thick file of memoranda and reports bound together in a red folder indexed with 12 gray tabs. Its contents included a Defense Department study and recommendations, a National Security Council brief, and an assortment of articles and editorials.

Carter pored over the technical data, particularly material on developing one possible alternative to the B-1, a highly maneuverable, long-range cruise missile. He concluded that cruise technology could work and that such missiles would penetrate Soviet defenses. Furthermore, top-secret research, code-named Have Blue, showed promising signs that cruise missiles—and perhaps airplanes as well—might be made barely detectable by radar.

Carter felt confident of his ability to make the technical military decision. On a yellow legal pad he wrote 47 points, pro and con, on the bomber question. He rated each one—a modest argument got two points, while a strong one got five. He totaled the points. They added up against the B-1 bomber.

On June 30, Carter publicly announced he would cancel production of the B-1. However, to guard against “the unlikely event that more cost-effective alternative systems should run into difficulty,” Carter said, \$442 million more would be devoted to the B-1 program, primarily to finish the fourth and last R&D plane. He called his choice “one of the

Keeping the Rockwell production lines near Palmdale, Calif., open depended on saving the B-1 despite Jimmy Carter's resolve to kill it.

most difficult decisions I've made.” His main reason for canceling the B-1, the president explained, was that the “B-1, a very expensive weapons system, basically conceived in the absence of the cruise-missile factor, is not necessary.” To his close advisors, Carter had given two more reasons, aside from military arguments. He had made a campaign promise and wanted to honor it. And killing B-1 production would demonstrate his decisiveness, while delaying production or starting it slowly would not.

Money intended by the Ford administration for the B-1 would be diverted to modernizing and equipping B-52 bombers to carry cruise missiles. Research, development, and production of 3,400 cruise missiles would proceed at maximum speed. R&D would begin on a possible new jet to carry cruise missiles.

Carter's decision was resisted in a bitter eight-month congressional battle in which the B-1's supporters tried to overrule him by ordering construction of the first two production models of the bomber. If those two planes were built, the production lines at Rockwell International, the prime contractor for the plane, could stay open until 1980. At that point, Carter might change his mind or be de-

A Cast of Characters



THE PRESIDENTS

Seven U.S. presidents have faced decisions on the B-1 and its predecessors. DWIGHT EISENHOWER(1), JOHN KENNEDY(2), LYNDON JOHNSON(3), and JIMMY CARTER(6) considered blocking a new strategic bomber. RICHARD NIXON(4) and GERALD FORD(5) supported it. In October 1981, RONALD REAGAN(7) ordered the production of 100 B-1s.

THE ROCKWELL ROSTER

Rockwell president ROBERT ANDERSON(8) and B-1 program director BUZ HELLO(9) campaigned for the bomber with the aid of public-relations man MICHAEL DEEVER(10), whose other major client was Ronald Reagan.

feated for reelection. If either should happen, the bomber program would be in a position to move ahead at top speed, which would mean that 240 B-1s would be built, generating hundreds of millions of dollars in profits.

On December 6, 1977, the House flaunted Carter with a 191-166 vote calling for building the first two battle-ready B-1s to launch a fighting fleet. That night, Rep. Bill Chappell (D-Fla.), who led the congressional fight to overturn Carter's decision, celebrated over dinner at Trader Vic's restaurant in Washington with Rockwell lobbyists. House Speaker Tip O'Neill approached their table, offered his congratulations, and broke open a fortune cookie. Its message, he said, was "What is done today can be undone tomorrow."

O'Neill had read his fortune cookie correctly—at least for the immediate future. On February 22, 1978, President Carter, backed by O'Neill and Democratic loyalists, finally prevailed in the House against congressional-industrial pressures to start building B-1s.

The Secret War to Save the B-1

For Carter, at least, the bomber was now dead, and taken at face value, Congress had assented in his decision. But anyone who assumed the plane was really dead and buried underestimated the forces committed to the B-1. The air force, the manufacturers, their allies in Congress, and their supporters in the Carter administration—including some of the president's own high-ranking Pentagon appointees—refused to admit defeat. For these members of the defense network, no decision was ever accepted as final—unless they won it.

Watching television in his office in El Segundo, Calif., Rockwell's B-1 program director Bastion "Buz" Hello received word of Carter's B-1 victory in Congress with a mixture of disappointment and relief. Although production would not begin on the B-1 force, at least the \$442 million had been saved to build research plane number four, which had not even been assembled. Without that plane, Rockwell and the air force would lack a bomber fully equipped

THE CONGRESSIONAL TEAM

In the fight to overturn Carter's decision against the B-1, House Armed Services Committee members **RICHARD ICHORD (11)**, a Democrat from Missouri, and **WILLIAM DICKINSON (13)**, a Republican from Alabama, echoed the views of powerful staffer **ANTHONY BATTISTA (12)**. California Republican **ROBERT DORNAN (14)** teamed up with Democratic colleagues **ALAN CRANSTON (15)** of California and **JOHN GLENN (16)** of Ohio to get the B-1 through Congress and win jobs for their constituents.



THE EXECUTIVE ADVOCATES

Two prominent scientists appointed by Carter — **HANS MARK (17)**, the secretary of the air force, and **SEYMOUR ZEIBERG (18)**, a deputy undersecretary of defense — opposed his directive to halt B-1 production. They teamed up with air force generals **THOMAS STAFFORD (19)** and **KELLY BURKE (20)**.

with the offensive and defensive avionics systems necessary to demonstrate that the B-1 could effectively penetrate the Soviet Union.

Within minutes of hearing of the B-1's defeat in Congress, Hello received a telephone call from Rockwell president Robert Anderson at the company's headquarters in Pittsburgh. "Quiet the troops down, try to be statesmanlike, and don't say anything you will regret," cautioned Anderson. The Rockwell president then left his office, went to the Concordia Club, and had three martinis for lunch. Returning to his desk, Anderson began to plan with Hello how to keep the bomber project alive.

Bob Anderson viewed life as a competition. Winning was his tonic—whether the prize was a tennis trophy or a multibillion-dollar government contract. An outstanding engineer himself, Anderson had started out at Chrysler Corp., where he graduated first in his class from its technical institute. He set high goals for production and profits, and expected his managers to meet them. He led by example, outworking everyone else. When, at age 51, he assumed

responsibility for Rockwell's aerospace division, he learned how to fly an airplane. By arriving at an air force base behind the controls of a Rockwell Sabreliner executive jet, he intended to show the generals he knew their business.

With test-plane number four safe with nearly a half-billion dollars for R&D on its way, Hello and Anderson set about hoarding the critical personnel and material on hand. At government expense, Rockwell stored the parts already purchased for 11 airplanes, in addition to 50,000 machine tools and 500,000 pounds of precious aluminum and titanium sheets from which future planes could be built.

Rockwell also engaged in some fancy bookkeeping. According to government auditors, the company illegally charged some of its B-1 costs to its other government contracts. Although Rockwell never admitted to any guilt, it eventually reimbursed more than \$1.5 million to the government and agreed to institute bookkeeping reforms. (Rockwell was not unique. Several other giant defense contractors, including General Dynamics and General Electric,

*Few
members of
Congress realized how much
research money was being
funneled into Rockwell
and the air force to
advance the
B-1.*

were caught using similar practices.)

To proceed further would require help from high levels of the air force and the Defense Department. That help came from two air force generals and two distinguished scientists in the Carter administration.

Hans Mark, the secretary of the air force, and Seymour Zeiberg, deputy undersecretary of defense for research, engineering, and space, were certain the president had made a bad decision. Both men thought the nation needed a new penetrating bomber, and they were determined to keep the B-1 alive. Both were members of the elite group of nuclear scientists who had risen to powerful policy-making roles in government after successful academic careers. They exemplified the binding ties between the military, industry, and the nation's most prestigious research universities.

As a scientist as well as a nuclear strategist, Mark believed strongly in high-performance weapons systems. He had chaired the department of nuclear physics at the University of California at Berkeley, and for eight years had served as director of NASA's Ames Laboratory, which conducted advanced experimental work on space weaponry. In 1977 he joined the Carter administration as undersecretary of the air force; in 1979 he became secretary.

Zeiberg was the second-highest Pentagon official directly involved in R&D of new nuclear-weapons systems. At the Aerospace Corp., a research center funded by the air force, he had worked on problems of reentry physics aimed at improving intercontinental ballistic missiles (ICBMs). Tired of theoretical studies, he said he took the Pentagon job because he wanted to do the hands-on work of getting the hardware built. Bombers, Zeiberg believed, with their ability to project force rapidly anywhere in the world, could be the global peacekeepers of the twentieth century.

Allied with Mark and Zeiberg were Lt. Gen. Thomas Stafford, air force deputy chief of staff for research and development, and Maj. Gen. Kelly Burke, an assistant to Stafford. Starting out as a test pilot, Stafford had become one of the most famous U.S. astronauts, commanding both the Apollo 10 flight to the moon in 1969 and the Apollo-Soyuz linkup in space in 1975. Later, as commander of

Edwards Air Force Base, he had directed the B-1's test-flight program. By 1978, he was in charge of all air force R&D. After the B-1 cancellation and other defense cutbacks, the astronaut-general was heard to refer to the president as "that peanut farmer."

Kelly Burke, a wavy-haired, cigar-smoking Alabaman, had also been a pilot. As an undergraduate at Auburn and graduate student at George Washington University, he earned degrees in history and international relations. Although he had commanded a Strategic Air Command (SAC) squadron, his academic background appeared to give him a point of view broader than that of the SAC commanders like Curtis LeMay who had hitherto run the air force.

Unlike their predecessors, Burke and Stafford accepted the fact that the ICBM had forever changed the nature of warfare. If the bomber were to survive, its advocates would have to formulate new reasons for its existence.

Working in tandem with the generals, Mark and Zeiberg managed to inject another \$450 million beyond the \$442 allocated earlier into the B-1 project, most of it earmarked for Rockwell. Pentagon officials have considerable independence in spending millions of dollars in R&D funds, and some of them quietly used their discretion to help keep the B-1 alive. In the budget the funds usually appeared designated only as R&D for "penetration studies," "advanced avionics," "cruise-missile-carrier studies," "radar-absorbent-material studies," "electronic-countermeasure studies," or "strategic-bomber enhancement." Seldom did they bear the label "B-1."

A Rose By Another Name

Taking the funds patched together from apparently unconnected programs, Rockwell and the air force continued to develop the B-1's avionics. In maneuvers against U.S. fighters and radar systems, they tested its ability to penetrate the Soviet Union. A model plane built by Rockwell and the air force demonstrated that the B-1's visibility to radar might be reduced by rounding surfaces, using new paints, and changing the engine configuration.

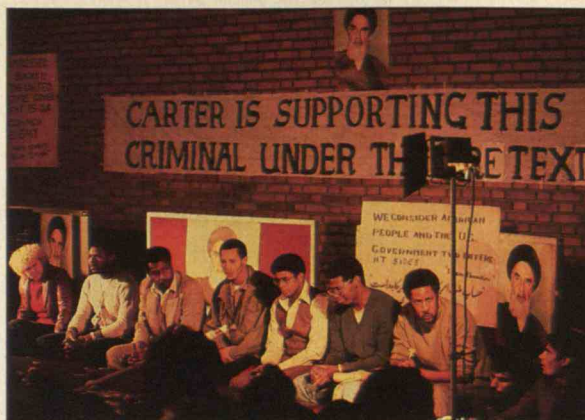
Few members of Congress, even those on relevant

subcommittees, realized how much research money was being funneled to Rockwell and to the air force to advance the B-1. But several key members of the House Armed Services Committee involved themselves deeply in the project. Their leader was not an elected member of Congress, but Anthony Battista, staff director of the House Armed Services Subcommittee on Research and Development.

Battista could serve as prototype for the important but obscure congressional staffer, operating behind the scenes, who exercises power far in excess of his official status. Battista directed the congressional oversight of hundreds of military programs, and he kept up with the details on all of them. He championed the B-1 and other strategic nuclear weapons, and his views generally were accepted by the subcommittee's chairman, Richard Ichord (D-Mo.) and William Dickinson of Alabama, the ranking Republican member.

The congressional team of Ichord, Dickinson, and Battista joined Rockwell's Buz Hello to devise a plan to bring back the B-1 bomber. Battista called it "playing Carter's game." The president had asked Congress to investigate the development of a new airplane whose main role would be to carry and launch cruise missiles. The B-1 advocates saw an opportunity for their Rockwell bomber to become that cruise carrier—or at least to adopt its disguise until the time was politically ripe for it to reemerge as a penetrating bomber. The three men worked on the details of a modified B-1, which they decided to call the strategic weapons launcher, or SWL.

Over lunch at the 116 Club, a gathering place for lobbyists and politicians near the Capitol, Hello and Ichord discussed how to save the B-1. Ichord agreed with Hello's assessment that at that point, late in 1978, Carter looked politically strong and probably would be reelected. The president's public stature had risen that September when he negotiated the



In late 1979, the political climate was more favorable to the B-1. The Soviet Union had invaded Afghanistan, and 66 Americans had been taken hostage in Teheran.

Camp David Accords, a peace settlement between Israel and Egypt. If Carter were reelected, Hello said, "it would be the bloody end for the B-1." Clearly, the best way to keep the plane alive was to turn it into the SWL.

At a second meeting in California, Ichord, Dickinson, Battista, and his assistant Tom Cooper met with Rockwell's Hello and his Washington lobbyists. Hello described plans to convert the B-1's movable swing wings into a simpler fixed wing, eliminate the bomber's supersonic speed, and sharply lower its price. He said Rockwell could deliver 100 born-again SWLs for \$8 million to \$10 billion. It would be Ichord's and

Dickinson's job to move the scheme forward in Congress. Everyone in the cabal understood that the SWL served as a Trojan horse for the B-1. "The only way to get the B-1 is to keep it alive for the next president," said Ichord.

By late 1979, the political climate was changing, favoring greater defense expenditures. A fundamentalist Moslem insurrection had toppled the shah of Iran, and in early November, 66 Americans were taken hostage in the U.S. embassy in Teheran. As they were held month after month, enraged and frustrated Americans at home wanted to retaliate.

In this atmosphere, Mark thought he might advance a budget proposal for a new bomber. Therefore, the air force slipped its bomber proposal into its preliminary 1980 defense budget plans, identified by the neutral acronym CMCA, for cruise-missile-carrier aircraft. But when B-1 opponents at the Office of Management and Budget reviewed the budget before forwarding it to the president, they added the identification "(B-1)."

When the president reviewed the budget with Defense Secretary Brown, he spotted the item. "I hope I'm dreaming," he said angrily. "Can't we ever get out of this?" He slashed CMCA (B-1) from the budget

*Thanks
to three years of secret
help from the Pentagon and
some members of Congress, Rockwell
could claim the B-1 was ready to
roll when Ronald Reagan
became president.*

submitted to Congress.

Risking the president's fury, Mark, Zeiberg, and Burke forged ahead anyway. They decided to try a new strategy for justifying the B-1—complete with still another acronym. Speaking on December 12, 1979, to the National Security Industrial Association, the defense contractors' trade association, Gen. Burke, who had succeeded Stafford as vice chief for R&D, unveiled their creation. "I'd like to avoid the much too narrow term 'penetrating bomber,'" said Burke. "For want of a better term, I'll refer to the concept as a long-range combat aircraft or LRCA."

The LRCA represented a significant change in the way the air force perceived the mission of a strategic bomber. Since the beginning of the nuclear age, the SAC-dominated air force had single-mindedly promoted the strategic bomber for one exclusive purpose—to penetrate and attack the Soviet Union in a nuclear conflict. But a growing number of air force officers realized this narrow vision of the B-1 was militarily anachronistic as well as politically self-defeating. If the issue was the capability to strike the most vital Soviet targets, the bomber could never compete with ICBMs in either military effectiveness or cost.

To get a bomber, the air force would have to turn its thoroughbred into a workhorse. Burke therefore outlined other roles for the LRCA: even more significant than the traditional bomber doomsday role would be the LRCA's ability to supplement theater, medium-range nuclear forces. In a larger-scale nuclear or conventional war in Europe, he noted, "a force of LRCA might provide our only means for adding mass firepower at the right spot and at the right time to blunt the massive armored spearhead attack."

Burke did not raise, much less answer, the question of whether a plane costing \$100 million to \$200 million was needed to perform these missions—or whether it was wise to risk such an expensive weapon except for the most critical purpose.

Turning the Corner

The next event to advance the LRCA was more important than anything B-1 proponents had planned.

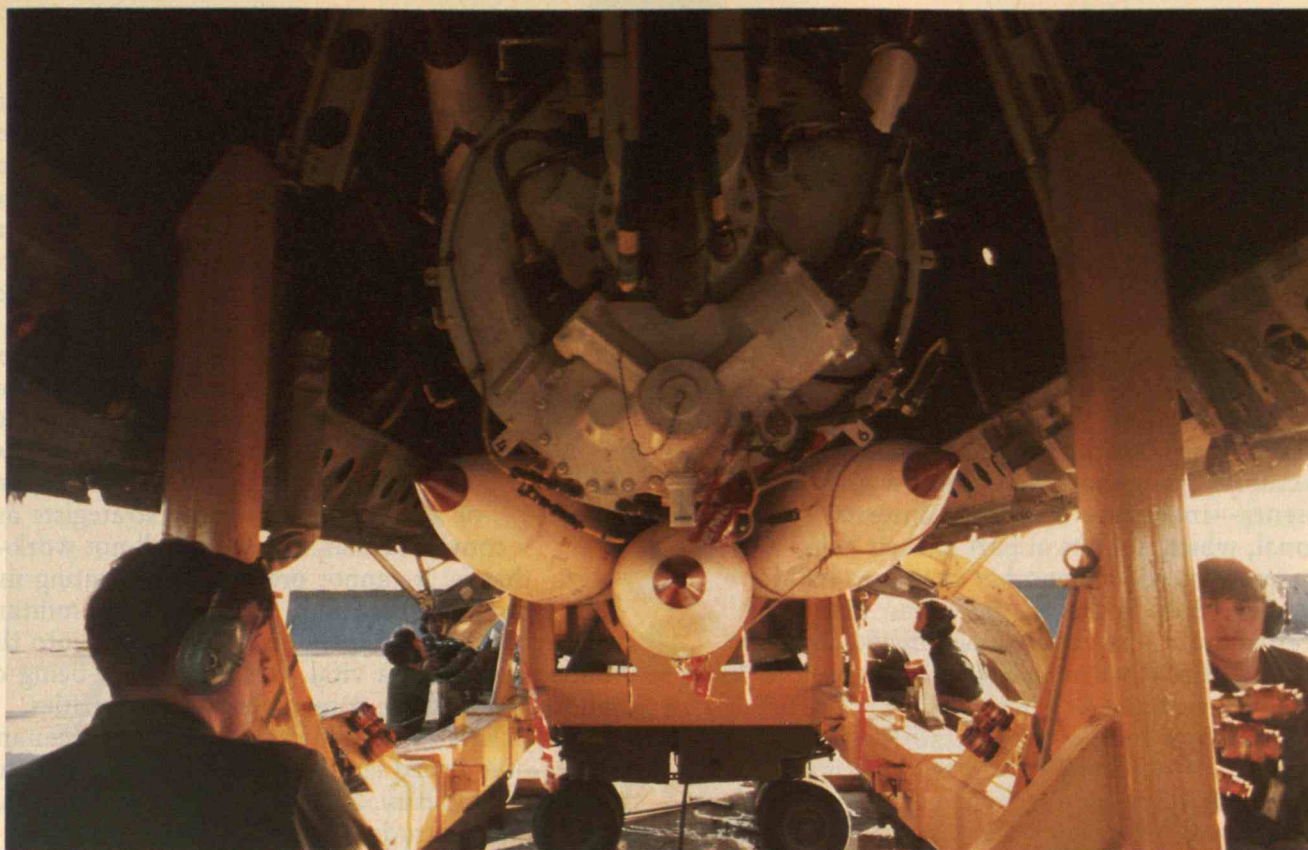
On December 27, 1979, Soviet tanks rolled into Afghanistan. President Carter was stunned. The event, he said, caused him to reappraise his views on the nature of the Soviet threat. He canceled grain sales to the Soviet Union and U.S. participation in the forthcoming Moscow Olympics. In his State of the Union address on January 23, 1980, he called the invasion "the most serious threat to peace since World War II."

A few days after the Soviets moved into Afghanistan, air force secretary Hans Mark convened a meeting of his service's senior commanders at the Air War College in Alabama to discuss Burke's LRCA concept. Mark's message was as political as it was military. "Because of Afghanistan, the situation has broken," said Mark. "There now is a climate of public opinion in which we can talk about the bomber." When the meeting ended, the air force's leaders were ready to go public with their demand for a new bomber. Furthermore, Mark felt Carter would not be reelected, which made it even more imperative to advance the precise case and perfect the technology for a revised version of the B-1 that a new president could immediately start.

For his new B-1, Mark needed the blessing of opinion leaders in industry, science, and the military. Toward that end, he ordered the air force's Scientific Advisory Board to study the bomber question at its annual summer meeting in Monterey, Calif. The board included distinguished military analysts, aeronautical experts from academia and industry, and air force generals.

Although the men had come to study bombers in general, the agenda was carefully planned to advance precisely the revised B-1 that Burke, Mark, and Zeiberg had shaped with Rockwell. The "stealth bomber" option—a plane that would be invisible to Soviet defenses—was not even considered and was so secret that few participants were even aware of it, although M.I.T. scientist Eugene Covert came up with the same idea out of his own abstract musings. When Edward Teller, usually a reliable bomber supporter, wandered from the prescribed solution, a general was assigned to divert him.

The meeting achieved its purpose. The Air Force Science Advisory Board, Teller included, endorsed the modified B-1—a.k.a. LRCA, a.k.a. SWL.



In deciding to cancel the B-1, President Carter reasoned that cruise missiles would be a better bet. In the end, both were built.

The Parable of the Born-Again Bomber

As the 1980 session of Congress unfolded, it quickly became apparent that both the Democrat-controlled Congress and the military would follow their own agendas, ignoring a weakened President Carter, who looked like a lame duck even though he was running for reelection. In the House, Tony Battista and his congressional allies moved the B-1 forward, thinly disguised as the SWL. Ichord and Chappell rounded up Democratic support, while Dickinson and Californian Robert Wilson, the ranking Republican on the House Armed Services Committee, worked on their GOP colleagues, many of whom seized the chance to embarrass Carter.

On May 14, the House voted 297 to 119 to approve \$600 million for development and initial production of the SWL. The true purpose of the exercise was colorfully outlined by Robert Dornan, the California Republican in whose district the plane would be built. "Castrate it, cripple it, call it whatever you want," said "B-1 Bob," but vote for the SWL "if you want the chassis on the assembly line in January. . . . We can then turn it from a station wagon into a Ferrari!"

The SWL did not fool Carter. He told Democratic leaders in the Senate, where the issue had not yet been debated, that he would veto the entire defense bill if it contained the bomber appropriation. The B-1 bomber had come back to haunt the president,

pushing him into a political corner. If he resurrected the bomber, admitting a mistake, he would look indecisive. If he vetoed the legislation, he would confirm the contention of Republican presidential contenders that he was weak on defense.

Senate consideration of the bomber began late in June. After midnight on July 1, Alan Cranston (D-Calif.) and John Glenn (D-Ohio) brought onto the Senate floor a strategy to advance the B-1. Both Democrats were running for reelection, and their two states contained more B-1 jobs than any others. Glenn and Cranston introduced a clever amendment that would salvage the B-1 while saving face for the president and senators who supported other options. The amendment called for the next president to present plans for a new bomber early in 1981. It could be the revised B-1 (or LRCA), a modification of the existing FB-111, or an entirely new advanced-technology bomber.

Any of the three, that is, so long as it was the B-1. Using a common ploy, Glenn and his legislative aide Robert Andrews drafted the amendment in language so specific that only the revised B-1 could meet the strict requirements. The proposal passed 53 to 37, and the House and Senate finally agreed on the Glenn-Cranston plan. The new president would have \$350 million and a March 15, 1981, deadline to come up with a plane.

*The nation
has built dozens of
expensive weapons systems
in a disorderly and wasteful
process influenced by
questionable assessments
of military
need.*

In January, Jimmy Carter walked out of the White House and back into private life. Other politicians left office at the same time—some through the so-called revolving door that connects the various halls of the defense community. Richard Ichord and Bob Wilson retired from Congress and set up business as Washington lobbyists. Eight major defense manufacturers immediately signed on as clients—including Rockwell International, which, thanks in part to their help, was now poised for another chance to build the B-1. Bob Andrews, the Glenn aide who drafted the crucial Senate amendment, also went to work for Rockwell. His new job was to lobby Congress to build B-1 bombers.

Revolving in the opposite direction, Michael Deaver, a California public-relations man, became a key aide to President-elect Reagan. For three years, Deaver and his partner, Peter Hannaford, had represented two major clients, Ronald Reagan and Rockwell International. In December 1980, Deaver, as aide to President-elect Reagan, arranged for Robert Anderson and Buz Hello to meet with Reagan's transition team on defense. Thanks to three years of preparation, with the secret cooperation of the Pentagon and some members of Congress, the Rockwell officials could claim that the B-1 was "ready to roll." Fulfilling his own campaign promises, President Ronald Reagan in October 1981 ordered the production of 100 B-1s, and a new stealth bomber as well.

Out of Control

After 30 years, the B-1 is more than a bomber. It has become a cause that sheds great light on how defense decisions are made. Our huge military establishment is driven by powerful dynamics other than mere differences of opinions about the relative merit of various weapons or military strategies. Decisions are influenced at least as much by psychological, political, and economic factors. The nation has built dozens of expensive weapons systems in a disorderly and wasteful process influenced by questionable, self-interested assessments of military need:

□ The U.S. Navy continues to win approval for expensive super carriers, despite compelling evidence of their vulnerability.

□ The U.S. Army is seeking \$60 billion to \$80 billion worth of new helicopters for transporting troops and providing them with close air support. These

vehicles are highly vulnerable to enemy attack. Numerous seasoned military leaders have contended that the helicopters are ineffective and wasteful, and that their role could best be performed by air force planes.

□ The nation has embarked on what could become the most expensive defense program in human history: the Strategic Defense Initiative (SDI), or Star Wars. Dozens of scientists and nuclear strategists are convinced that Star Wars will not work—that is, it cannot prevent a devastating nuclear attack on both U.S. cities and military targets. Yet SDI spending already runs into the billions and plays a vital part in the well-being of hundreds of defense companies and universities.

The self-interested politics and economics of many parties—the armed services, Congress, the president, the defense industry, and large chunks of the American public—intrude into almost every aspect of a weapon's conception, development, manufacture, and deployment. When these special interests assert themselves—through the democratic process or on its margins—the results are predictable: billions wasted on weapons and military facilities we don't need, weapons deployed at strategically impractical locations, a defense strategy that lacks coherence, and mindless acceleration of the arms race. After a continuous 30-year defense buildup, marked by such repeated excesses, the military program is totally out of control.

Political leaders from the president on down have avoided facing the consequences of the enormous role defense spending has assumed in the nation's overall economy. Protecting the nation's defense industrial base is a sensible policy, but it should not be executed informally and secretly while the government pretends it is choosing the best and most cost-effective proposals for particular defense requirements. The problem with passing contracts around—either to fulfill a vaguely defined need for national defense preparedness or to protect the nation's general political and economic health—is that it often results in higher costs, poorer products, or unneeded weapons.

Defense programs are sometimes sustained primarily because no one has sought economic alternatives to them. Communities have developed a severe defense dependency; they feel that their economic well-being depends on a particular military base or plant. Defense spending has become a narcotic, and the country is hooked. □

MIT

APRIL 1988

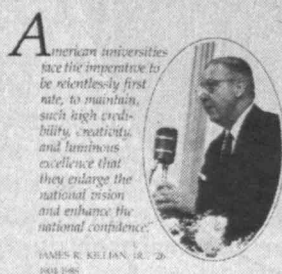
A*merican universities face the imperative to be relentlessly first rate, to maintain, such high credibility, creativity, and luminous excellence that they enlarge the national vision and enhance the national confidence."*

JAMES R. KILLIAN, JR., '26
1904-1988



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MIT



ABOUT THE COVER:
Though M.I.T. was James R. Killian Jr.'s "intellectual and spiritual home," in his death on January 29 all of higher education lost a powerful and uniquely eloquent advocate. (Photo: M.I.T. Museum)

Divestment Redux; Draper and Internal Combustion

DANGEROUS TO DIVEST

I read with interest Stephanie Pollack's letter (*January, p. MIT 2*) supporting divestiture of M.I.T. funds from [companies doing business in] South Africa. I would like to present another view.

I think it would be very dangerous for M.I.T. to accede to outside pressure to divest. It would establish a precedent that would encourage other groups to put pressure, financial or otherwise, on the Institute to accede to their views and would make it more difficult for M.I.T. to maintain independence.

Divesting only from South Africa would make no ethical or moral statement. To make a statement against government-sponsored discrimination, M.I.T. would have also to divest from such countries as Israel, whose government seems bent on persecution of Palestinians. To make a statement against repression, M.I.T. would have to divest from such countries as the Philippines, where the government under Corazon Aquino seems to consider the crowd control method of choice to be shooting at protestors until they disperse.

Divesting from South Africa would, however, make a political statement. I disagree with the statement that would be made, which I take to mean "it is better for South Africa to undergo economic collapse and a subsequent bloody and divisive war than for it to maintain a sufficiently high standard of living for blacks and Asians that they have the luxury of worrying about discrimination and some chance of gradually removing that discrimination."

A continuation of M.I.T.'s present policy is the closest M.I.T. can come to remaining politically neutral, since it consists of making investments to maximize economic return, irrespective of political implications.

Perhaps the most constructive course the M.I.T. Endowment for Divestiture

could take would be to provide scholarships for black South Africans. The expertise they would gain at M.I.T. would be of significant value to their country and could be used by them as a lever to guide the South African government away from the policy of apartheid.

WARREN J. DEW '81
 Alexandria, Va.

MORE DRAPER ACHIEVEMENTS

None of the many tributes to Charles Stark Draper, '26 (*see November/December, p. MIT 43*), has noted that from 1929 to 1935 while he was studying for a doctorate in physics Draper worked in the Sloan Laboratories for Aircraft and Automotive Engines. He made important contributions to understanding the phenomenon of "detonation" in internal-combustion engines and developed new instruments for its observation and measurement. He also studied engine vibration and designed instruments for its measurement. His doctor's thesis, "Physical Processes Accompanying Detonation in the Internal Combustion Engine," was a result of this work. Draper was a licensed pilot and published a paper on his measurements of engine vibration in flight, using an instrument of his own design.

Draper gave up his work in the Sloan Laboratories in 1935 to join the faculty in aeronautical engineering, thus beginning his by-now-well-known career in instrumentation and control.

C. FAYETTE TAYLOR, '29
 Brookline, Mass.

The author is professor of automotive engineering emeritus and former director of the Sloan Automotive Laboratories.

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Watching the Door: Who Gets In, Who Doesn't, and Why

While he was an undergraduate at M.I.T. in the late 1970s, Eduardo Grado, '83, worked part time as a bouncer at a Boston night club. Watching quietly as people entered the club's world of raucous laughter and smooth talk, he slowly came to realize that some of his fellow-bouncers were consistently giving blacks and Hispanics a hard time.

Bitterness grew beneath the jocund exterior of this young Mexican-American from El Paso.

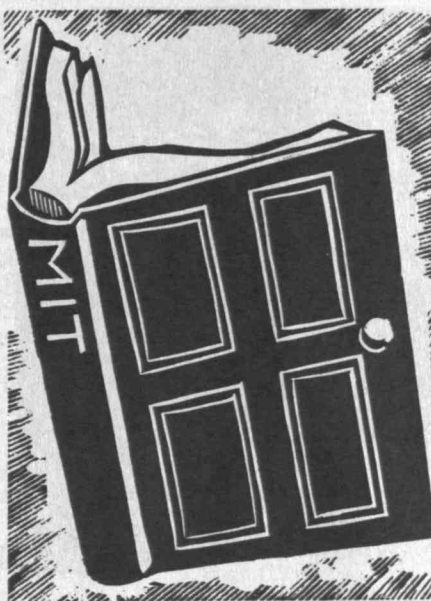
Ten years later, the memory of that experience is still vivid. But now, as coordinator of minority recruitment and assistant director of admissions at M.I.T. Grado is a doorkeeper of another kind: he and his colleagues are trying to ensure that underrepresented minorities (blacks, Hispanics, and Native Americans) have equal access to M.I.T.

They are running into trouble.

Not only is it hard to identify minorities who are qualified for M.I.T., but for some reason, a significant number of the minority students admitted to the Institute are not completing degrees. While 85 percent of the white students admitted to M.I.T. graduate within six years, only 75 percent of the blacks do so.

There is no way to know whether minority students at other institutions, particularly those in science and engineering programs, are any more successful than those at M.I.T., since Grado knows of no other school that makes such figures available. But in some sense, it makes no difference: if one of every four black students admitted to M.I.T. does not graduate, that is a problem.

One has to ask if the academic and social environment at M.I.T. has a negative impact on the achievement of blacks, Hispanics, and Native Ameri-



**SAT scores
are actually a
poor predictor of college
success.**

cans. Or is the Admissions Office, in its zeal for affirmative action, admitting students who aren't prepared, students who will have to struggle just to get by here—even fail—thereby doing injustice to young people who could excel at other colleges?

There is clear evidence that the M.I.T. environment does present special problems for black students. A report published by the Office of the Dean for Student Affairs in the fall of 1986—*The Racial Climate on the M.I.T. Campus: A Report of the Minority Student Issues Group (MSIG)*—says as much, basing that judgment on interviews with 20 percent of M.I.T.'s black alumni (see May/June 1987, p. MIT 4).

The report concluded that the pace and pressure of M.I.T. life experienced

by all students are exacerbated for minority students. In part, that is because too many white faculty members offer minimal support, convey negative expectations, or display outright discriminatory behavior. Many alumni also reported that "racial and cultural barriers, racial incidents, and misunderstandings (were) prevalent in the living groups." The black alumni said that racist attitudes and action too often undermined their confidence.

The problems persist for today's students. Edward Page, a junior in electrical engineering, says that minority students are under a lot of strain to prove that they are equal to other students in the classroom. Many minority students are more troubled by the lack of role models in science and engineering—there are too few black and Mexican-American professors, individuals who share the concerns and backgrounds of minority students and can provide advice and example.

The Numbers Problem

But the most important problem, students say, is minority numbers. "If we had more minorities on campus, allowing for more day-to-day contacts—contacts at random, not clinically scheduled—between minorities and whites, then maybe we could break down the walls," says Norman Fortenberry, a graduate student in mechanical engineering.

Minority numbers at M.I.T. are small. In 1986-87, blacks made up about 5 percent of the undergraduate population, Mexican-Americans 3 percent, Puerto Ricans 2 percent, and Native Americans less than half a percent. These figures mean that there is often only one minority student in a class. When white students work in informally assembled teams in labs, on projects, and on problem sets, that minority student can be isolated, required to cope academically without collaborators. It's a big liability.

The number of minority students at M.I.T. reached a peak in 1981 and then began to decline as a result of a drastic



THOMAS T. HUANG, '86, IS A GRADUATE STUDENT IN ELECTRICAL ENGINEERING AT M.I.T.; HE IS EXECUTIVE EDITOR OF THE TECH.

*M.I.T. must
go beyond recruiting;
it must help public schools cultivate
minority talent.*

drop in the number of black freshmen experienced by colleges nationwide. By 1985, only 40 blacks entered M.I.T. as freshmen—4 percent of the class—compared to 65 the previous year. Michael C. Behnke, director of admissions, called the situation "very disturbing."

Since 1985, thanks in part to efforts of the Admissions Office, minority admissions have been on the rise. Minorities made up 13 percent of the Class of 1991, and M.I.T. administrators say they are determined to maintain the present rate of increase. While doing that, however, the Admissions Office still has "a professional obligation to take only the people we feel can succeed here—people who can do the work," in Behnke's words.

In its admissions process, M.I.T. uses the Scholastic Aptitude Tests (SATs) as one predictor of the likelihood an applicant will succeed at the Institute. The average math SAT score of the Class of 1991 was about 730. In 1985, the College Board reported that only 184 blacks and 156 Mexican-Americans throughout the United States scored 700 or above on the math SAT, and those numbers continue to be small.

As far as Grado knows, M.I.T. enrolls a larger percentage of the 700-and-above minority scorers than any other institution in the country except Harvard, and he sees little prospect that we can increase our proportion of minority students by drawing more heavily on that limited pool.

Building a Critical Mass

Grado and his Admissions Office colleague Clinton Elliott are convinced that the only way the Institute can build a critical mass of minority students—enough to provide a comfortable environment for each other and dramatically alter perceptions of the abilities of minority students—is to go beyond recruiting. M.I.T. will have to *cultivate* minority talent.

Accustomed to grim pictures of dilapidated classrooms and statistics of drug addiction, teenage pregnancy, crime,



Eduardo Grado

and staggering drop-out rates, we tend to disbelieve that there are bright, talented kids in America's inner cities—kids who happen to be black, Mexican-American, and Asian, and who deserve a chance. But Grado and Elliott—whose office makes more than a thousand phonecalls every year to talk to minority high school students, for example—know that the kids are there. They want institutions like M.I.T. to develop concrete programs, utilizing students, alumni, and staff, to help the public schools identify and nurture talented young people.

Along with cultivating talent, M.I.T. needs to develop strategies for evaluating students that are more accurate than test scores for predicting which students are equipped, emotionally and socially as well as intellectually, to thrive here. There are students who have 800 scores on the math SAT who do poorly or fail, Grado says. So an effort to improve evaluation of applicants will benefit all students, not just minorities.

Another change, even closer to home, would also help. For years the minority community has been asking that M.I.T. reduce its self-help level (the amount of

money students must contribute from loans or term-time jobs towards educational expenses) for low-income students. The present figure of \$4,900 looms large for many students, particularly minorities. It's \$1,000 higher than that of Harvard, Yale, and Princeton and as much as \$3,000 higher than Stanford's.

Last September, M.I.T. announced an experimental \$1 million Opportunity Awards program that would give about 125 students in the lowest income category grants of up to \$2,500 per year to reduce their self-help levels.

Three months later, the Committee on Undergraduate Admissions and Financial Aid proposed that the Institute alter another current policy, under which M.I.T. reduces its aid to any student who obtains a non-M.I.T. scholarship, dollar-for-dollar. A decision on how that policy will be applied in the future is pending.

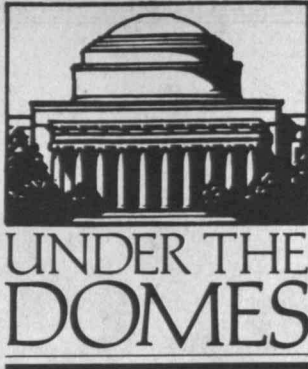
Despite these moves, Grado foresees no large increase in minority admissions in the short term. The pool of students ready to enter M.I.T. this year is limited, and other top universities are competing more effectively for the best minority students. To expand its enrollment of minorities, M.I.T. will have to look beyond test scores, admissions and financial aid formulas, and traditional incentives, says Grado.

Make No Mistake, He's Speaking Up

When he was a student, returning to his Baker House room after working at the night club, his clothes still smelling of cigarette smoke and stale beer and his ears still ringing from disco music, Grado sometimes brooded about the blatant discrimination he saw. He would ask himself what he could do about it.

Now Grado has come full circle. He stands at the door of an institution altogether different from a smoke-filled night club. But he's still watching who gets in and who doesn't and thinking about what can be done to make sure that everybody gets a fair shake.

And this time, make no mistake, he's speaking up. □



Course XX Discontinued

The Department of Applied Biological Sciences (Course XX), formerly the Department of Nutrition and Food Science and before that the Department of Food Technology, will be discontinued by the end of the 1988-89 academic year.

The 86 graduate students now enrolled will be able to complete their degrees, and it's expected that most members of the faculty will find places in other M.I.T. departments, according to Gene M. Brown, dean of science. The undergraduate program in Applied Biology (Course VII-A), which has been conducted jointly with the Department of Biology, will continue under the aegis of the latter.

The decision results from the dean's judgment, supported by John M. Deutch, '61, provost, that the department does not have the strength in a single discipline or theme that is necessary for graduate teaching and thesis research. Rather, he said, the department embraces a diversity of activities that ranges from molecular biology to chemical engineering and includes microbiology, nutrition, food processing, genetic engineering, toxicology, and biochemical engineering.

Such diversity makes it more like an interdepartmental laboratory than an academic department, Brown said.

In a statement in *Tech Talk*, Brown emphasized that M.I.T.'s goal in terminating the department was "not to reduce the number of faculty or the total financial resources being spent." Rather, he said, the purpose is to focus available resources on "the strongest intellectual opportunities," locating them in departments such as biology and chemical engineering where they will fit well. But he agreed that ultimately "the number of faculty will be reduced."

At present, the department includes 21 faculty, 8

research scientists, and more than 40 postdoctoral associates and fellows. It conducted more than \$10 million in sponsored research in fiscal 1987, second only to chemistry among departments in the School of Science.

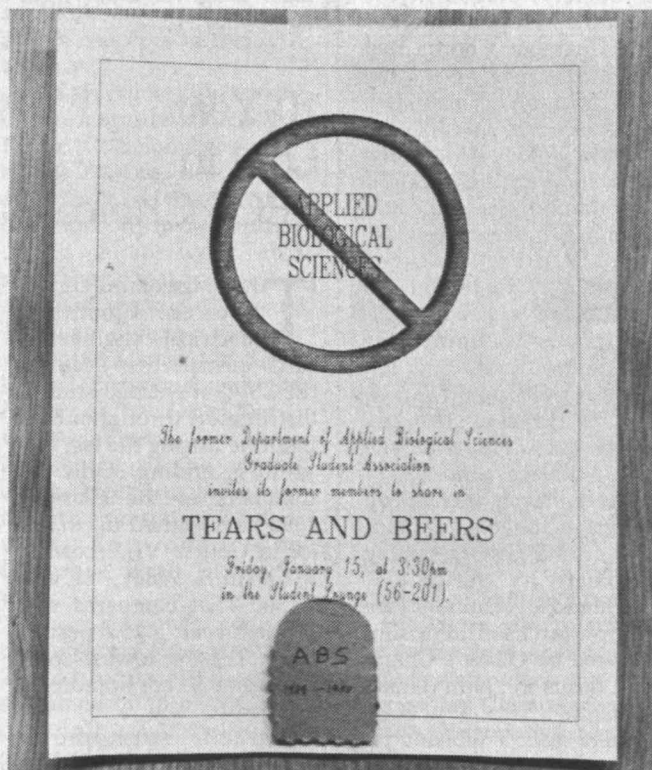
The problem of focus had been raised from time to time in the past several years, according to Brown, but it proved unyielding. Members of the faculty report little or no discussion, however, during the months before the special meeting at which the decision to end the department

was announced. Professor Gerald N. Wogan, head of the department, had not been "substantially involved in the decision," *The Tech* said after interviewing one of his assistants, and the visiting committee was not consulted at length. Wogan himself refused to comment.

Many of the department's tenured faculty are widely known in their fields—Marcus Karel, Ph.D. '60, in food engineering; Alexander M. Klivanov in enzyme biochemistry; Robert S. Langer, Jr., Sc.D. '74, in pharmacology and drug delivery systems; Robert S. Lees in dietary factors in cardiovascular disease; Nevin S. Scrimshaw in international food and nutrition; William G. Thilly, '67, in environmental chemistry, toxicology and human disease; and others. Daniel I. C. Wang, '59, who is director of an interdepartmental Biotechnology Process Engineering Center (supported as a "center of excellence" by the National Science Foundation), holds a joint appointment in chemical engineering and applied biological sciences.

Professor Cho Kyun Rha, '62, a specialist in the physical and engineering properties of biomaterials, was "shocked" by the decision, she told *The Tech*. "Our department is so unique . . . (It has) such a high-standing program." Robert Lees agreed, fearing that the demise of the department could "potentially do a lot of harm" to important and successful research programs.

The department origi-



Anguish and anger were shared by students and faculty when the end of the

Department of Applied Biological Sciences and its Course XX were announced.

nated at M.I.T. as the "industrial biology option" in the Department of Biology. Its success in the handling and production of food-stuffs led to the formation of the Department of Food Technology in 1945. Later, as nutritional biochemistry gained emphasis, the name was changed to the Department of Nutrition, Food Science and Technology and soon to the Department of Nutrition and Food Science. Further changes were reflected in 1985 when its present name was adopted. □

Music Room for Liz

MI.T. has its first "salon" for small musical events.

What many graduates remember as the Hayden Gallery in the Hayden Library became available for a new use when art exhibitions moved to the List Gallery in the Wiesner Building. The space has been transformed into a concert hall and named in honor of the late Elizabeth Parks Killian. Mrs. Killian was M.I.T.'s first lady in fact for the ten years of the presidency of her husband, the late James R. Killian, Jr. '26, and in spirit until her death in November 1986.

Even in its first few weeks of use, the new room stimulated a plethora of musical events designed especially to capitalize on its intimacy and ambience. A week before the dedication concert



Even before its dedication, Killian Hall was proving its value to M.I.T. musicians. Four members of the Chamber Music Society are shown rehearsing for a re-

cital there in December. Clockwise from the top, they are Richard Olson, '91, Samuel Osofsky, '88, Albert Lew, '91, and David Wootton G.

on December 13, John Oliver, director of the Choral Society, staged in the room the first performances of a Chamber Chorus that *The Tech's* reviewer, Jonathan Richmond, called "fabulous. . . . In hardly any time at all Oliver has spirited up an ensemble of rich, warm sound, discipline and seemingly unbounded energy. Killian Hall was packed. . . ." There was also praise for two soloists, graduate student Chinny Yue ("glowing, polished soprano") and Kenneth Goodson, '89 ("a voice that can wax lyrical to illuminate the beauty of each word").

The all-Bach dedication concert included a brief cantata and a Brandenburg Concerto by the M.I.T. Chamber Players under Professor Marcus Thompson, followed by Oliver's Chamber Chorus in "Nun danket alle Gott."

There was a jubilant response from Thompson: "the first space dedicated for the use of music at M.I.T.—the end of our nomadic existence."

"Mother, this would have turned you on," said the Killians' daughter, Carolyn Killian Staley. □

10-Year Low in EECS Choice

The bulge of undergraduate enrollments in electrical engineering and computer science (EECS) that warped student distribution throughout the Institute during the last four years is ending. Only 277 members of the Class of 1990 have signed up to major in Course VI, according to David S. Wiley, '61, registrar. That compares with 329 last year, a 15.8 percent drop. It's the lowest count of Course VI sophomores in ten years.

Indeed, sophomores choosing majors in most departments in the Schools of Engineering and Science are down this year, while the numbers declaring majors in

management, architecture and planning, and humanities and social sciences are climbing.

For example, the number of sophomores declaring for Course XVII—political science—is up from three last year to eight this year, and the Political Science Department is pondering how it can serve an increasing number of undergraduate majors if the trend continues.

The shifting enrollment pattern is "just what we set out to do," says Michael C. Behnke, director of admissions; he and the faculty committee on admissions with which he works have sought a wider spectrum of interests in M.I.T.'s undergraduate applicants. The Undergraduate Academic Support Office also claims a share of credit for its efforts to better acquaint freshmen with the wide variety of options in many departments at M.I.T. □

No Growth in Research

For the first time in four years, the volume of on-campus research at M.I.T. showed no growth in constant dollars during the year ending June 30, 1987.

Total campus research in 1986-87 was \$262.75 million, up from \$256 million in the previous year, according to Robert M. Dankese, director of fiscal planning and budget. That 2.6 percent increase matched almost pre-

cisely the inflation rate between the two years.

Lincoln Laboratory research volume was \$353.7 million in 1986-87, up 20 percent over the previous year. It was the fifth straight year of real growth in Lincoln's research.

Major sponsors of on-campus research in 1986-87 were the Department of Energy (\$55 million), the Department of Health and Human Services (\$47.3 million), the Department of Defense (\$45.4 million), and the National Science Foundation (\$38.1 million). Industrial sponsors provided a record \$36.6 million. □

A Philosopher of Love

A monumental trilogy on *The Nature of Love* was completed late last year by M.I.T. philosophy professor Irving Singer. Charles H. Ball of the M.I.T. News Office took the occasion to talk with Singer, and here are excerpts from his report:

What turned M.I.T. philosophy professor Irving Singer onto love? Or, more precisely, the idea of love, the nature of love, the concept of love.

"Well, my psychological motivation, I suppose, is my own deficiency, the feeling that I may not be as loving as a person as I might be," Singer told me. But that self-deprecating response probably wasn't as serious an indictment as it seemed, because Professor Singer's

studies have shown that love is far too complex a notion for anyone to feel very confident of having mastered it in practice. What Singer has mastered, however, over a period of 25 years is a uniquely comprehensive documentation and analysis of the subject.

Singer's 1,400-page trilogy is a philosophical history of the Western concept of love. Its general title, *The Nature of Love*, is followed by subtitles for each volume: *Plato to Luther*, *Courtly and Romantic*, and *The Modern World*, in which the evolution of love is traced through the development of philosophical, literary, and scientific concepts in the 20th century.

In a prepublication review of the completed trilogy, Robert C. Solomon, author of *The Passions*, describes it as "one of the major works of philosophy in our century... a masterwork and sourcebook that will be the standard work in the field. There are quite a few books with axes to grind and polemical flirtations with the history of the idea of love," writes Solomon, "but there is nothing of the scope, depth, care, and the attention to comparison, contrast, and nuance to compare with Singer's work."

Singer acknowledges that the subject of love, until the 20th century one of the most examined of all philosophical topics, has been neglected of late. Why? "Because it doesn't lend itself to logical rigor," Singer replied, "and it is difficult to deal with scientifically." □

39th Is Ok

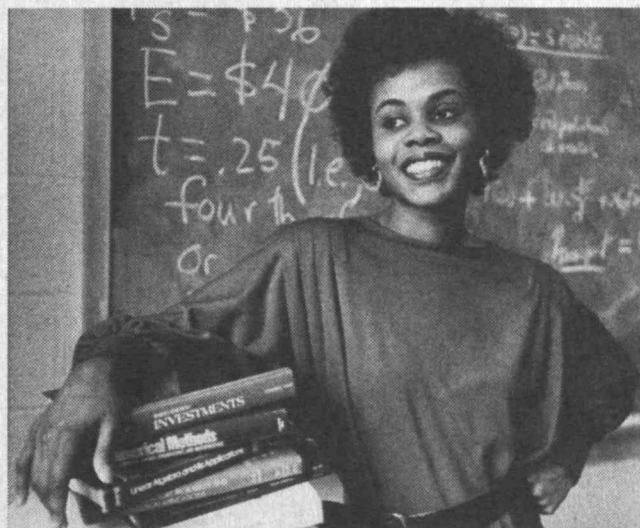
In number of volumes, staff, and expenditures, M.I.T.'s libraries rank only 39th among those of 109 leading American universities, according to a 1985-86 Association of Research Libraries study.

But Jay K. Luckner, director of libraries, is unperturbed.

That's just where we should be, he told Mary Condello, '89, of *The Tech*. Compared with science and engineering in which most M.I.T. students work, Luckner explained, such

fields as history, literature, and the other humanities are much more dependent on books. Medical and law schools, too, require large and specialized collections.

But that's not to say that the libraries are without problems, Luckner emphasized. Most of those problems are financial, he said—driven chiefly by the rising number of journals and their escalating cost. But funds are needed, too, he said, for staff salaries and book acquisition, and he called attention to the library endowment included among the goals of the Campaign for the future. □



A splash of publicity came to Iris Maria Mack, assistant professor of applied mathematics, when she was among *Glamour* magazine's Outstanding Young Women early this year. Since graduating from Vassar 10 years ago she studied at Berkeley and Harvard (the second black

ever to receive a doctorate in applied mathematics there), worked at Jet Propulsion Lab, Bell Labs, and Salomon Brothers on Wall Street, and (since last fall) taught at M.I.T. Her goal of a career as an astronaut was thwarted and perhaps permanently sidetracked by the Challenger accident.

KILLIAN COURT

NAMED IN HONOR OF
JAMES R. KILLIAN, JR., '26
JUNE, 1974





James Rhyne Killian, Jr., '26

*"To the end of
his life he championed M.I.T.'s causes
with skill and tenacity
ennobled by love"*

By John I. Mattill

James Rhyne Killian, Jr., '26, whose contributions to M.I.T. and to the nation's science, technology, and culture were extraordinary by any measure, died at the age of 83 on January 29 at his Cambridge home.

Killian was president of M.I.T. from 1949 to 1959, chairman of the Corporation from then until 1971, and thereafter honorary chairman until his final retirement in 1979. Meanwhile, he had served as the first White House science adviser (to President Dwight Eisenhower) and later as chairman of the Corporation for Public Broadcasting, conceived during a study of educational broadcasting that Killian led.

"He was a great American statesman, educator and humanist whose monuments are all around us," said President Emeritus Jerome B. Wiesner. "Those of us who knew and worked with Killian have lost a warm and wise friend whose life we were fortunate to share."

President Paul E. Gray, '54, described Killian as "a man of vision, grace, wit and wisdom." He has had a "remarkable influence on this special place for 60 years," said Gray, "an interval of nearly half the Institute's history in which the modern M.I.T. was planned, shaped, and built."

Killian's college education began at Trinity College (now Duke University) in 1921 as a freshman from Blacksburg, S.C. He transferred to M.I.T. after two years, intending to prepare for a career in textiles, his father's field. He chose to major in business and engineering administration, including an essential core of engineering studies—thermodynamics, mechanics and

machine design, and electrical engineering.

The major in management stuck. But the career plans that had brought Killian to the Institute were permanently altered by teachers such as Eric Hodgins, '22, Frank Aydelotte, William C. Greene, and, above all, Robert Emmons ("Tubby") Rogers. Together with others, they conducted in M.I.T.'s Department of English and History what Killian called "a brilliant liberal arts college within an engineering school," and he found there "stimulating teaching" and a "benign influence."

Almost immediately upon his arrival in Cambridge, Killian became a features writer for *The Tech*, and in 1925-26 he was editor. Completing his year as editor, Killian wrote a statement of the paper's goals that clearly reflected its author's unusual literary bent and skills: "In the conduct of the paper we have tried religiously to get away from hackneyed methods of acquiescing to every drive and movement that rises among us. We have preferred to keep in the region of fresh and stimulating discussion. . . . That is, we have chosen the Mencken method."

One admiring reader of the *The Tech*'s Mencken-inspired journalism was Harold E. Lobdell, '17, assistant dean of students. During Killian's undergraduate years Lobdell doubled as editor of *Technology Review*, for which Killian occasionally wrote. In 1926, Lobdell asked him to serve as assistant managing editor of the magazine, shelving for good Killian's plans to enter the textile industry.

So began the M.I.T. career whose out-

lines are familiar to most readers of the *Review*. Killian became managing editor of the magazine in 1927 and editor in 1930. By the end of the 1930s he was increasingly involved in M.I.T. administration activities, notably in the organization of what is now the M.I.T. Press and as a confidante of Vannevar Bush, '16, dean of engineering and vice-president.

It was Bush who suggested that Killian join the M.I.T. president's office upon the former's departure to become president of the Carnegie Institution of Washington in 1938. Though Killian clearly felt uneasy in the role, it was an invitation that he could not turn down; in his memoir, *The Education of a College President*, Killian noted that "my previous career could best be described as idiosyncratic preparation for university administration."

But as President Karl T. Compton became increasingly involved in federal programs anticipating U.S. involvement in World War II, Killian found himself assuming greater and greater responsibility in Cambridge, becoming executive vice-president in 1943 and vice-president and member of the Corporation in 1945. Finally, in 1948, when Compton was asked by President Harry S. Truman to chair the Research and Development Board, he proposed to the Corporation's Executive Committee that Killian should be made the Institute's tenth president.

Eleven years later Killian relinquished that task to his close associate, Julius A. Stratton, '23, under similar circumstances. The Soviets' launch of Sputnik prompted President Dwight D. Eisenhower to seek a better understanding of science in national policymaking, and in 1957 he asked Killian to be the first White House science adviser. The two formed a warm bond of respect and friendship. In his memoir *Sputnik, Scientists, and Eisenhower*, Killian tells of visiting Eisenhower at Walter Reed Hospital during the latter's final illness. Eisenhower reflected on the President's Science Advisory Committee, of which Killian had been chairman: "This bunch of scientists was one of the few groups that I encountered in Washington who seemed to be there to help the country and not help themselves."

Eight years after he went to Washington for Eisenhower, Killian was again chosen for major service in the public domain: the Carnegie Corp. asked him to head its Commission on Educational Television. The result was "public" television, in Killian's words "a new kind of indigenous noncom-

mercial institution arranged to serve American society in all its diversity."

Through all this time, Killian professed that M.I.T. was his "intellectual and spiritual home" and his "top priority." To the Institute, more than to any other of the many institutions with which he was involved, he brought a combination of wisdom, skills, sensitivities, and instincts that together set his leadership apart.

"No single individual in this century has done more to advance M.I.T.'s purpose and plan," said President Emeritus Howard W. Johnson.

"To the end of his life he championed M.I.T.'s causes with skill and tenacity ennobled by love," wrote David S. Saxton, '41, chairman of the Corporation.

During the period of Killian's presidency, M.I.T. annual operations increased almost three-fold. He was the chief architect of two capital fund programs, the \$20 million Development Program that ultimately yielded more than \$25 million, and the \$66 Million Second Century Fund that raised \$98 million. The total of annual giving to M.I.T. rose from \$2.5 million in 1949 to \$7.7 million in 1958.

The campus was substantially transformed during Killian's presidency—creation of the Sloan School of Management and its installation in new facilities; completion of the Hayden Library; new buildings for hydrodynamics, metals processing, biology, physics and computer science, and athletics; new auditorium, chapel, and student residences; and the M.I.T. Reactor. The Second Century Fund made possible a second wave of new construction—buildings for earth sciences, materials, life sciences, and space research; the Student Center, boathouse, and women's residence.

Killian's concern for education extended far beyond the halls of M.I.T. He was a strong advocate of the Physical Science Study Committee (PSSC) programs to improve secondary-school physics education, and in the 1960s and 1970s he was active in such programs as the President's Commission on National Goals and the Sloan Commission on Government and Higher Education. He held honorary degrees from no fewer than 39 colleges and universities.

"The central challenge facing American universities," Killian wrote in 1985, "is the imperative to be relentlessly first rate, to maintain such high credibility, creativity, and luminous excellence that they enlarge the national vision and enhance the national confidence."





Highlights of a lustrous career (clockwise from top left):

With President Julius A. Stratton, '23 (left), and Vannevar Bush, '14, dedicating the Bush Building in 1965.

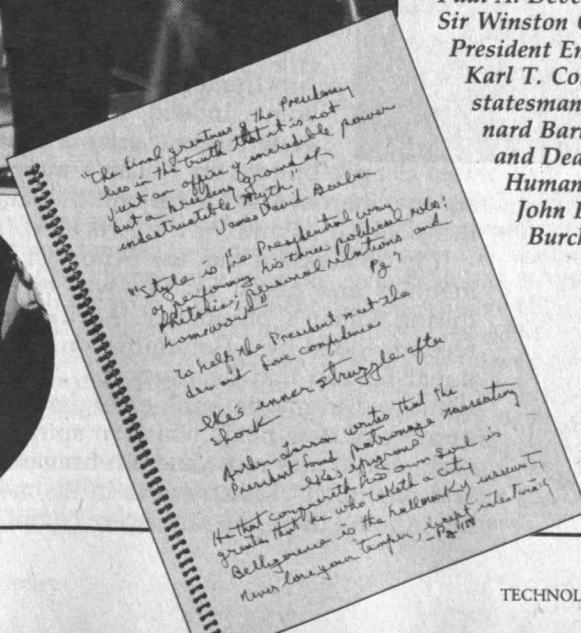
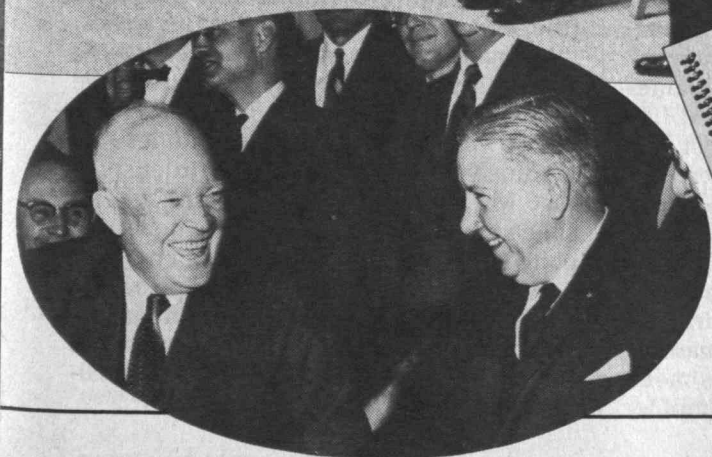
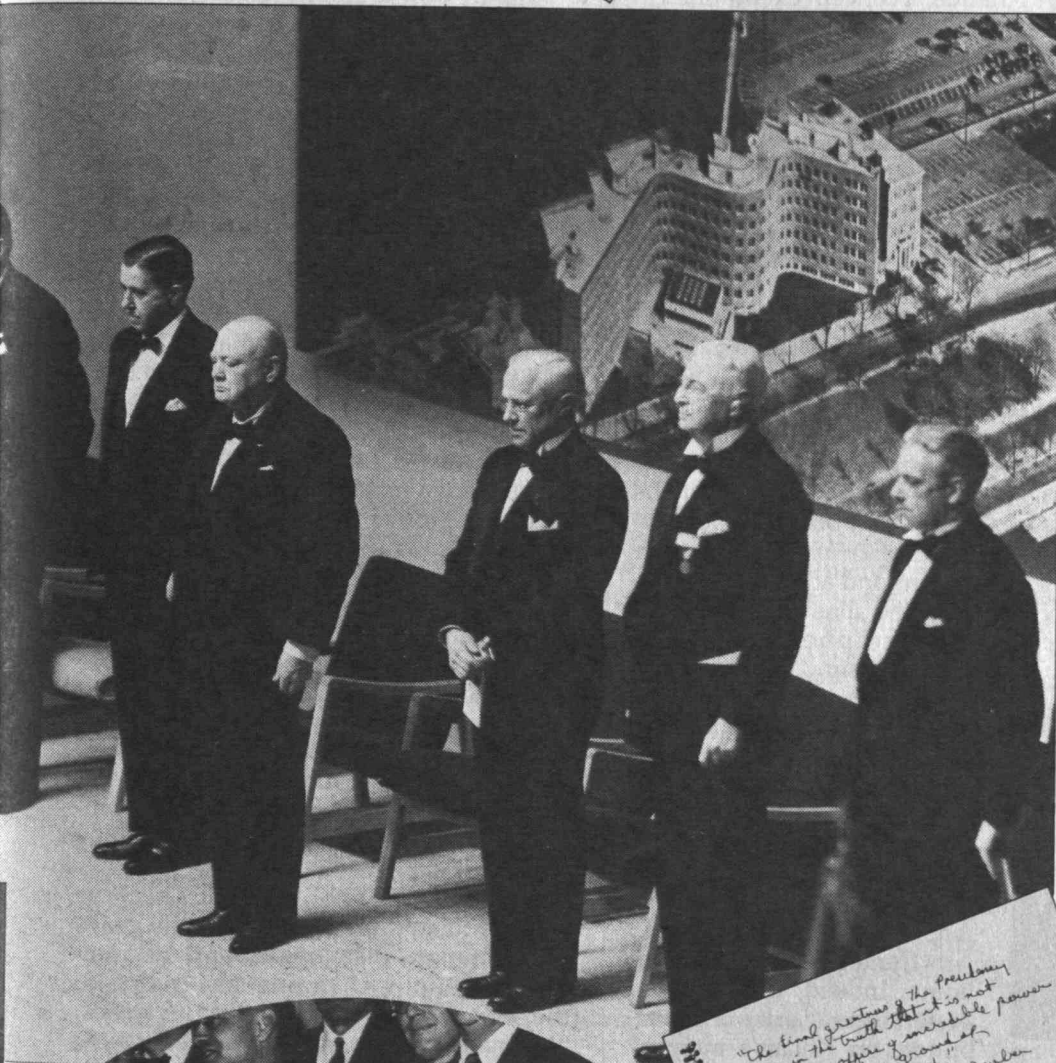
Magazine and television coverage for the first White House science adviser.

Below: a page from one of Killian's many journals, with notes on the White House years.

Working with President Eisenhower.

With Alfred P. Sloan, Jr. '95, celebrating the success of M.I.T.'s first post-war capital fund drive in 1951.

Sharing the Mid-Century Convocation stage (left to right) Dean of Students Everett M. Baker, Massachusetts Governor Paul A. Dever, Killian, Sir Winston Churchill, President Emeritus Karl T. Compton, statesman Bernard Baruch, and Dean of Humanities John E. Burchard, '23.



Following the examples set by Bush and Compton, Killian was a major participant in U.S. science and technology policymaking, first on committees serving President Harry S. Truman and—after his service to President Eisenhower—on a host of important government panels. Throughout, he was guided by several deeply held convictions: that management of the nation's science and technology must be in civilian—not military—hands, a concept exemplified in his blueprint for the National Aeronautics and Space Administration; that sociotechnical, political, and international issues involving science must be the subject of expert advice to the government; and that the threat of nuclear weapons must be reduced.

Wiesner, later himself a White House science adviser, describes Killian as “the architect of the science advisory system.” In an editorial tribute, the *Los Angeles Times* said Killian made certain that “in a world on the verge of incredible scientific and technical discovery, the White House was open to the discoverers.”

Killian's interest in and support of the arts is a less recognized but important dimension. As editor of *Technology Review* he sought contributions and advice from leading typographers and illustrators, including etcher/photographer Samuel V. Chamberlain, '18. He shared in teaching a course in typographic art at M.I.T. and took charge of a course in magazine editing and design at Simmons College. Later he was an advocate of the Council for the Arts at M.I.T., the Museum of Fine Arts, Boston, and the Sharon (N.H.) Arts Center, near his summer home. Indeed, the two suggested beneficiaries of contributions in Killian's memory

are the Sharon Arts Center and the James R. Killian, Jr., Fund for the Arts at M.I.T.

It is no accident that the School of Humanities and Social Studies was created during Killian's presidency, having been recommended by a Committee on Educational Survey that he proposed. “I have witnessed in my time the emergence of a number of new fields which in spirit and method can and must be both humanistic and scientific,” Killian wrote in his memoir. Among them, he said, were computer

science, artificial intelligence, the cognitive sciences, and molecular biology. “I believe that the modern research university offers unique opportunities to cultivate many new integrations between the liberal arts and the sciences.”

No one who has read either of Killian's memoirs or heard many of his speeches can doubt his remarkable gifts with the English language. He was an insatiable reader, recording in personal journals passages that he enjoyed and retrieving them to support and illuminate his views and arguments.

The instincts of a communicator were pervasive. Honed at *The Tech* and *Technology Review*, they came into full flower in the heroic plan for a Mid-Century Convocation that brought Sir Winston Churchill and Harold Stassen to speak to an M.I.T. audience of nearly 20,000 in Boston Garden and Rockwell Cage in the spring of 1949. An indication of Killian's sympathetic understanding of the press and its role was the National Press Club's invitation for him to give a “farewell speech” as he was leaving his White House post in 1959.

Killian was the first alumnus to serve as president of the Institute, and alumni relations were a major interest. He travelled to alumni groups often and knew many alumni on a first-name basis.

As he approached retirement in 1971, he and Mrs. Killian made “farewell” visits to eight different alumni groups in as many U.S. cities. They were greeted by more than 5,000 alumni. Typically, Killian saw it not as a tribute to himself but as an opportunity for him once more to sense “the greatness of this institution by observing close up what its alumni have accomplished . . . and the variety of ways they have enriched American life.”

Another tribute to M.I.T. occurs near the end of Killian's memoir, where he notes “the traumas, distempers, and decrepitudes encountered during my trudge to (the) venerable age of 81.” But, he writes, “the manic excitements of university life have so enlivened my days, and freed me from boredom, that I still ‘hang in.’”

Two years later, those decrepitudes had gradually increased to be so burdensome that M.I.T.'s sense of loss must be assuaged by relief that Killian was no longer obliged to “hang in.” More than anything now there is a sense of deep and pervasive gratitude—that the community will have a chance to express at memorial services at 2 p.m. May 5 (in Kresge Auditorium) and on Technology Day. □

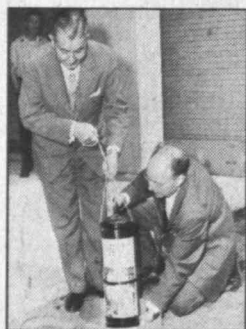


A lighter side of the Killian years:

Preparing with Mrs. Killian for a White House party, 1958.

With students in his fraternity, circa 1961.

Helping “Doc” Edgerton bury a time capsule under the Compton Building, 1957.





25 Years of Computer Games

A Birthday for *Spacewar!*

By Diana ben-Aaron

Spacewar! stands tall among the earliest video games—so tall that on the game's 25th anniversary late last fall Boston's Computer Museum staged a three-day celebration to which *Spacewar!*'s inventors were invited as guests of honor. The original *Spacewar!* game has been a popular exhibit ever since the museum opened; visitors can play it on an Apple Mac-Intosh computer and occasionally—if they're lucky—even on the computer on which *Spacewar!* was designed—Digital's venerable PDP-1.

Spacewar!'s authors, of whom three—Stephen "Slug" Russell, '60, Martin "Shag" Graetz, '58, and Alan Kotok, '62—came to the Computer Museum's bash, were the heroes of a talk-fest on the history and prospects of computer gaming. They are credited with pioneering the use of computers for recreation when they wrote the *Spacewar!* video game in 1962. They still remember how it began as a simple two-spaceship dogfight designed by Russell: players moved the ships around the screen, firing and dodging missiles, by flicking switches on the system consoles.

Thanks to Graetz, a player who got

into a tight spot could send his ship into "hyperspace," momentarily erasing it from the screen and repositioning it at random. Daniel Edwards, '59, added gravity, which pulls the spaceships toward the sun in the center of the circular, oscilloscope-like screen. Peter Samson, '62, laid out a starry background on the basis of real astronomical data. Kotok's biggest contribution was obtaining the basic sine and cosine routines, already written and stored on paper tape by an engineer at DEC, that enabled the computer to calculate the positions of the space ships on the screen after every move.

Flipping switches on the crowded console grew cumbersome as the players improved; so Kotok and Bob Saunders, '61, built joysticks from parts they found at the Tech Model Railroad Club.

Writing It Was the Best Game In Town

In the early days, says Kotok, *Spacewar!* was "definitely a social event" as well as a sharpening stone for programming skills. In early 1962 there was a more or less continuous *Spacewar!* tournament and hacking session going on whenever the PDP-1 was available, mostly at night. Champions played challengers and everyone took frequent breaks to refine the program.

It was a situation in which, in the words of Gwen Bell, founding president of The Computer Museum, the best

computer game was writing the game.

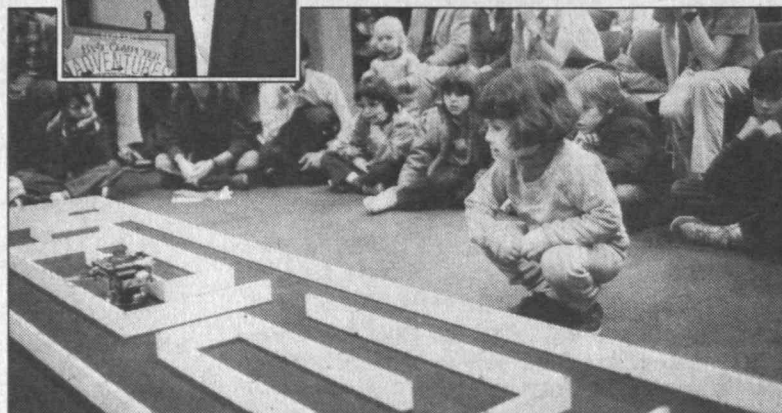
(Much of this history can be found in Steven Levy's *Hackers* (Anchor Press—Doubleday, 1984, reviewed in *Technology Review* for April 1985, page A15.)

All this programming for *Spacewar!* is alive today at The Computer Museum—and also in computers all over the country as the heart of elaborate video games from Atari, Cinematronics and others. "Just last month I saw yet another *Spacewar!* game on a DEC VAX color workstation," Kotok says. "It's still basically the same game—ships, thrust, torpedoes, hyperspace, everything. The thing that amazes me," he says, "is that no one ever looked at it and said, 'Gee, I bet we could sell this . . .'"

Participants in the Computer Museum's bash recalled that, technically, *Spacewar!* was not the first computer game. It was preceded at M.I.T. by *Tic-Tac-Toe* on the TX-0. Several other programs on the TX-0 also had some elements of gaming, notably the Mouse-in-the-Maze cartoon and the Hax pattern generator. A very simple paddle-ball game was simulated on a computer and displayed on an oscilloscope in the late 1950s at Brookhaven National Labs.

But these weren't really games according to the criteria of David Ahl, editor of the now-defunct *Creative Computing* magazine and author of four books of computer games. He lists three elements of a good computer game: gaming (fantasy, fun), elements of the

DIANA BEN-AARON, '85 works as an editor in New York City. Her undergraduate majors were in materials science and humanities; she was Editor in Chief of *The Tech* and a columnist for *Technology Review*.



real world (simulation), and a puzzle (problem-solving).

(*Creative Computing*, you may remember, used to print entire programs for games, which eager hobbyists would type in one line at a time whenever they wanted to play the game—this was before floppy disks, before quill pens, before anything. And before *Creative Computing* was when men wrote on cave walls by the light of torches.)

Using his own rigorous criteria, Ahl believes the first true computer game may have been Carnegie-Mellon University's *Management Game*, a simulation of the detergent industry that was first used as an exercise for graduate students of business in 1959.

Ahl worked on the *Management Game* and was instrumental in a later (circa 1964) spinoff called *Hammurabi*, in which the player makes the executive decisions of an emperor in ancient Mesopotamia—which crops to plant, what to do with the army, and so on. What with the plagues of locusts and famines and all, it was an awfully hard game in which to survive for long, and—like pinball—it was a game you won by surviving. In contrast to *Spacewar!*, which pioneered in using graphics, *Management* and *Hammurabi* were the first words-only games.

By the mid-'70s, the West Coast had produced yet another breed of computer games. From hackers at the University of California campuses in Santa Cruz

and Berkeley came *Rogue*, an electronic version of the popular commercial "interactive fiction" game, *Dungeons and Dragons*. *Rogue* involves a single player, who finds treasure and fights monsters while exploring a maze that paints itself on the screen as he or she feels it out. At Stanford, Will Crowther and Don Woods wrote *Adventure*, which gave its single player a similar find-treasure-and-kill-monsters goal—but no pictures.

The important difference between *Spacewar!* and the *Rogue* and *Adventure* games was that the former offered the challenge of two players pitted against each other. Players tended to find that "if you've written the maze, it's no fun being the mouse," according to *Rogue* pioneer Ken Arnold, who was also on hand at the November computer game birthday party.

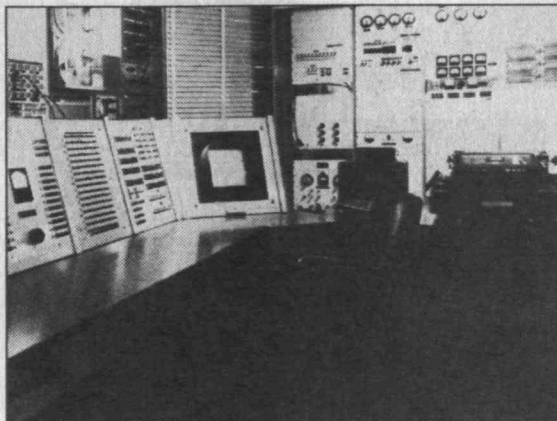
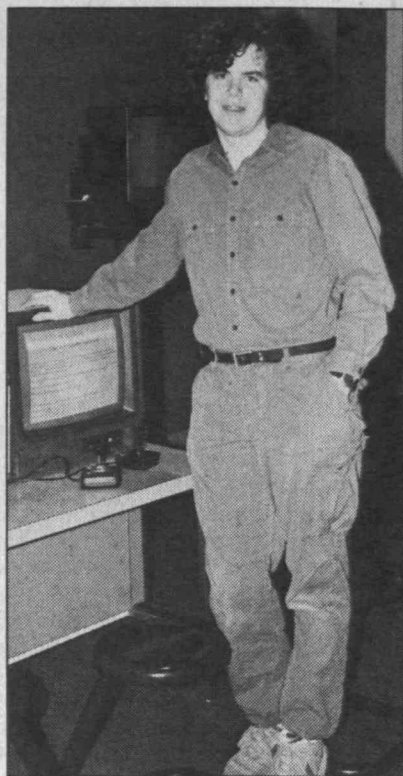
Nevertheless, *Rogue*—like *Spacewar!*—has spawned countless imitations, which, as Arnold says, "is the second most sincere form of flattery immediately after royalties, which I'm finally starting to get some of, thank God." (*Rogue* and a slightly more sophisticated version called *Hack* were major diversions on M.I.T.'s Project Athena system circa 1985.) Russell thinks that there's another difference between the old games and the new. Faster processors make the pace too fast, he says, rewarding quick reflexes rather than experience, marksmanship, and strategy.

The first commercial gaming venture was Atari, founded in Silicon Valley in

1972 by Nolan Bushnell. Atari's first product was a *Spacewar!*-type video game called *Computer Space*. It flopped, probably because it was too sophisticated for the taverns in which it was placed. It was rapidly followed by *Pong*, a simulated ping-pong game that took in money so fast machines had to be emptied daily instead of once or twice a week; later versions of *Pong* had a change drawer the size of a kitchen sink.

In 1978 came Atari's video computer system (VCS), which turned a television set into an arcade game—or hundreds of arcade games simply by changing Atari software cartridges. "No one device was more responsible for getting computers into people's homes," says Ahl. Unfortunately for Atari, the VCS turned out to be a fad and by 1984 the bottom had fallen out of the home arcade-game market.

A smaller success has accrued to "interactive fiction," which consists of professionally written *Adventure*-like text simulation games running on PCs and occasionally on minicomputers. Here the leader is Infocom of Cambridge, Mass., a spin-off from M.I.T.'s Laboratory for Computer Science that was organized by Joel Berez, '76, Michael Dornbrook, '75, Christopher Reeve, '67, and others—most of them former Lecture Series Committee movie jocks. Infocom is famous (and rich) for its *Zork* series, a direct descendant of *Adventure*,



(From far right, facing page) Computer game inventor and historian David Ahl; Stephen Russell, '60 (left) and Martin Graetz, '58, at the controls of the Digital PDP-1 on which they invented *Spacewar!*; a very young fan cheers M.I.T.'s Mitee Mouse, a maze-running robot; the games *Zork* and *Planetfall* brought success to Infocom, a spin-off from the Laboratory for Computer Science. (This page) Ben Blount, '90, who adapted *Spacewar!* for a Macintosh while still in high school; the controls of the TX-0, an awesome stage for a very early computer version of *Tic-Tac-Toe*. (Page MIT 13) In jackets and ties no less, two early players of *Spacewar!* on the PDP-1.

as well as science fiction games like *Planetfall* and interactive detective novels.

(Incidentally, Infocom hid *The Tech's* phone number in *Planetfall* as a character's ID card number. Many players recognize it as a phone number, call it, and ask for clues to the game, which *The Tech* doesn't usually have.)

Curing Computer-Phobia

Now that Atari's 15 minutes of glory are over, the market has cooled to a core of fanatics. But don't write the industry off yet. Though corporations often ban computer games as time-wasters, Ken Arnold, programmer of *Rogue*, said that in an ideal world games would be standard in business installations.

"It's part of what makes a computer environment friendly," Arnold says. "Working in a place that doesn't allow games is like not being able to hang up posters in your office or bring in a few juggling balls for when you're thinking. A game refreshes you, like taking a walk." Furthermore, computer trainers and social scientists say that playing games helps computer-phobic employees relax with their new machines.

Designers and enthusiasts at The Computer Museum symposium were pained that computer games haven't found the audience they believe the genre deserves. But they have no trouble understanding why. "It's such an uncomfortable way to entertain yourself," pointed out educational game de-

veloper Tom Snyder, miming an addict hunched over his keyboard. In addition to softening the point of contact with the user, text-type video games need more memorable characters and stories, he says. But he admits that gifted authors with the patience to write every possible ending to a story are rare. Chris Crawford, another game designer, agreed with Snyder on the blandness of computer-game content: "We have yet to get a character as rich, subtle, and complex as Gilligan of (the TV program) 'Gilligan's Island.'"

Game designer Dan Bunten sees the future of computer games not in single-player scenarios but in bringing people together, as board games always have. "If the computer is too interesting, then the people aren't," he explains. But C. Gordon Bell, '56, of Ardent Computer, argued that a true computer game is something new, not a simulation of a board game. "You can't do *Spacewar!* on a board," he said.

The Only Working PDP-1 in Captivity

"I'd like to invite you to come play a game that has no character development, where you only do one thing the whole time, where there's precious little action—but a lot of people seem to sit down and keep playing it," Graetz quipped, motioning toward the back of The Computer Museum's PDP-1.

The original *Spacewar!* PDP-1 is in the museum's collection, but succeeding

generations of hackers have altered it beyond repair. Graetz was pointing toward a shiny, new-looking PDP-1 donated by an anonymous corporation and rebuilt by DEC engineer Stan Schultz. It is believed to be the only working PDP-1 in captivity, and the machine is the heart of the museum's *Spacewar!* exhibit.

This PDP-1 is brought up only a few times a year for special occasions, but visitors can play *Spacewar!* any time on an adjacent Apple Macintosh. Ben Blout, '90 wrote the version of *Spacewar!* running on the Mac while he was still in high school.

The inventors of *Spacewar!* have scattered. Russell went to graduate school at Stanford and is now at Hasbro in California. Graetz is currently at Apollo Computer, Inc., in Chelmsford, Mass., and Kotok is a consulting engineer at DEC. But the *Spacewar!* gang still has a clubhouse. It's a room in The Computer Museum, behind the *Spacewar!* display, containing an ancient IBM typewriter modified as a teletype for the PDP-1, a pile of early DEC manuals, and four filing cabinets containing practically all the code ever written by the gang for the PDP-1 and TX-0 computers, neatly sorted and bound in looseleaf.

"One of the fun things about computer games is telling stories afterward," says Slug Russell. The continuing success of *Spacewar!* and its derivatives makes it fun to listen, too. □



ALUM NEWS

Melding Liberal Arts, Engineering

"Too many technologists have been sent into the world without the well-rounded kind of education they need to use technology wisely and well within society," says Robert M. Metcalfe, '68, founder of 3Com Corp., Santa Clara, Calif. "But I thought that instead of complaining about the mistakes of past engineers, I would do my part to make sure that we start sending out technical people who are better prepared to deal with the society they're in."

The result of that thinking was the establishment in 1987 of M.I.T.'s Robert M. Metcalfe Professorship in Engineering and the Liberal Arts.

Now Metcalfe's gift has come to fruition: Joel P. Clark, Sc.D. '72, professor of materials systems, and Peter C. Perdue, associate professor of history, are Robert M. Metcalfe Professors in Engineering and the Liberal Arts. They will use the funds that come with each chair to teach a new collaborative course on technology in Japan and the United States.

"To really understand international competition," says Clark, "one needs to understand the influences of history and culture as well as technology and management." For his part of the course, Clark will compare the origins, history, and characteristics of the

U.S. automotive and steel industries. Meanwhile, Perdue, whose specialty is East Asian history and languages, will teach such topics as the Japanese educational systems, labor-management relations, and economic regulation. □



An Wang

Risktakers to Team Players

If you want to be successful in a new business start-up, you must not only accept but relish a life of volatility and risk, and you must have colleagues who are comfortable with inconstancy and risktaking.

But you must also build a team.

Faced with these discordant demands, how does an entrepreneur with an exciting new idea mold aggressive risktakers into a goal-oriented team that can confront the inevitable adversities?

It's a crucial question. "The primary problem in entrepreneurship is not how to get the ideas but how to carry them through to success," said Howard S.

Stevenson of Harvard Business School. His address opened the annual workshop of the Enterprise Forum of Cambridge late last fall.

Here are suggestions from the experts recruited by the forum:

□ David A. Boucher, president of Interleaf, Inc., Cambridge: Seek people with a tolerance for ambiguity, pay well to get the best, make communication a priority, and provide strong direction. "Every significant failure I can identify at Interleaf resulted from inflexibility or lack of direction," he said.

□ John J. Cullinane, chairman of Cullinet Software, Inc., Westwood, Mass.: The key ingredients are good judgment and integrity. The tone is set by how things are done, not by how the manager says they should be done. "The manager's ethics have to be good in theory and in practice."

□ Richard E. Cavanagh of McKinsey and Co., Washington: In the beginning the manager—"the fella with the 'terrific' idea"—has to be in the middle of everything, the most important member of the team. But as the enterprise grows the manager has to change from chief to counselor, coach, communicator, and goal-setter—"the symbol of appropriate behavior."

There is no substitute for "spending inordinate amounts of time with customers and with employees," said Cavanagh. "This is the job."

But having said that, Cavanagh also had a word of caution to would-be entre-

preneurs: "Never let go of what is absolutely critical to your success." For example, said Cavanagh, think of Frank Purdue's constant concern for the two things that make his business unique—marketing and quality control.

From the audience, Kenneth P. Morse, '68, agreed. A successful manager, he said, must have "an intimate involvement with the clients—the only rudder in difficult times."

With a perspective of nearly 40 years at the helm of one of New England's legendary successful start-ups, An Wang echoed the message about teamwork. "No one can succeed alone," he said. "The ultimate test of an entrepreneur is his ability to identify the help he needs."

As for himself, Wang said that he chose to build Wang Laboratories, of which he is chairman and CEO, slowly, so that the company would not outstrip his ability to manage it. "The man who seeks success overnight is an opportunist, not an entrepreneur," he said. □

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(Counterclockwise from lower left) The well-travelled Woodbury at work on a beach in Holland; a quintessential Woodbury marine oil painting—this one a ship's wake; pen and ink drawings of shipboard and beach scenes; and his familiar figure on Ogunquit Beach in 1925, working on "The Bathhouse."



Woodbury: Painter of Force on Water

It probably would have astonished his contemporaries, who knew him as a painter of exquisite marines and landscapes, teacher, and a founder of the art colony at Ogunquit, Maine, to learn that Charles Woodbury held a degree in

mechanical engineering from M.I.T. (Class of 1886).

But there was a consistency in Woodbury's approach to the world. He had an engineer's fascination with the forces at work on a scene or object; the impact of light and wind on the surface of the ocean was his passion.

Woodbury lived from 1864 until 1940, and his career overlapped those of John Singer Sargent, Childe Hassam, and William Merritt Chase. A massive retrospective of Woodbury's work will run from March 19 until October 2 at the M.I.T. Museum.

One year out of college, Woodbury had his first one-man show, and sold 30 paintings. He went on to have more than 100 shows, and his paintings are in the collections of the Art Institute of Chicago, the Detroit Institute, the Fogg Art Museum, the Metropolitan Museum of Art, the Rhode

Island School of Design, and the Museum of San Francisco, among many others.

At the close of the century, Woodbury and his wife traded some of his paintings for a parcel of land in Ogunquit. In time the property became the setting for a thriving art school that operated between 1898 and 1939, interrupted only by illness and the first World War. It was a significant factor in establishing that area as a major art colony.

There were some scientific or technical aspects of Woodbury's work that conjure up his M.I.T. connection. In 1924, he rented a plane and pilot for the purpose of painting the landscape from the air, becoming the first artist to do so. A year later he collaborated on "The Art of Seeing," a treatise on studying drawing by working from slow motion films of animals and figures. And his six paintings—made at

one-half hour intervals—of a solar eclipse on August 31, 1932, can be seen at Chicago's Adler Planetarium.

Ironically, it was his focus on the sea that probably caused Woodbury's name to fade into relative obscurity, in the opinion of Terry Vose of Vose Galleries in Boston. In this country at the turn of the century, and in Boston in particular, the public adored paintings of children skipping in the woods and lovely ladies boating or sipping tea. Painters who didn't fit the mold were less likely to become household names.

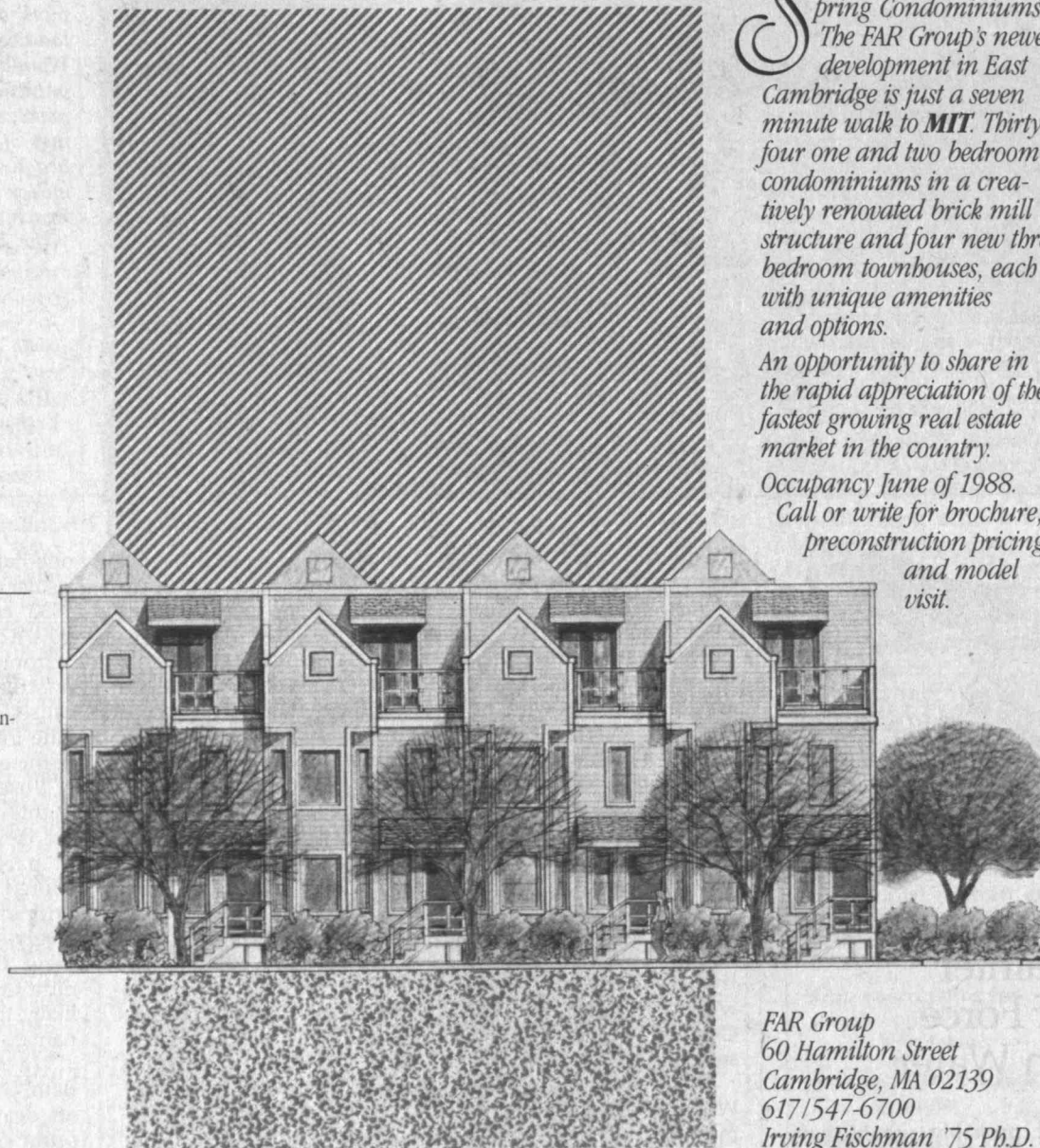
"In recent years," says Beth Urdang, a New York art dealer, "important museum surveys of the period have helped to reassess the contributions of all these artists." The M.I.T. Museum retrospective, the first extensive showing of Woodbury's work since 1952, is, in her words, "gorgeous and illuminating." □

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CLASS NOTES

13

Dorothy Rice, niece of **Marion Hart**, sends news about her aunt: "Marion is now 95 years old. She is well, but has difficulty writing. So I am writing for her. She was the first woman to graduate from M.I.T. in chemical engineering. She is the author of three books and numerous articles in flying magazines.

"Vanguard Press published *Who Called that Lady a Skipper?* in 1938. This book is written in the form of letters to her brother while she was sailing around the world in her own 72-foot ketch. She started in 1936 and took three years. *How to Navigate Today* was originally published in 1943, and a sixth edition was recently published (1986) by Cornell Maritime Press. It is a straightforward guide to celestial navigation. *I Fly as I Please* was published in 1953 by Vanguard Press. It is a story of her adventures in the air and her observations about reactions of people to her flying.

"Marion took up flying in her early fifties and subsequently flew the Atlantic Ocean in her single engine plane about ten times, seven of which were solo flights. Her last flight was in 1979,

when she was 87 years old and returning from Mexico. She landed in Tucson, Ariz., but she overshoot the runway. Fortunately, she was not hurt. Her airplane is now in the Pima Air Museum in Tucson."

According to the preface of *How to Navigate Today*, Marion has been "a research physicist, miner, surveyor, sculptor, painter, photographer, sailboat skipper, instructor, aviator, author, and radio operator. She has never been a noisy rebel flouting the conventions for women of her generation (she was born in 1891); she has just quietly done what she felt like doing, avoiding publicity and making a fuss only when she had to, to cut through red tape or to take a poke at pretension or stupidity.

"Mrs. Hart bought a boat in England in 1936—not so much a yacht as an enormous (90-foot, 50-ton) tub—and, after hiring and then firing in turn four variously incompetent captains, took over the skipper's job herself and sailed around the world, in three years, with a crew of young men. *How to Navigate Today* can be considered a by-product of that experience and of her conviction that existing navigation texts were too complicated and confusing."—ed.



Marion Rice Hart, '13 (above and below) put her foot down when her editor wanted to call her book about flying, With a Powder Puff in My Cockpit. I Fly as I Please more aptly describes the book, published in 1953, as well as her independent lifestyle. She retired from flying at age 87, after flying more than 5,000 hours.



Leo Dana, '17: Good Scientific Instincts

"Dana had that instinct for what is important that is the hallmark of all great scientists," says Russell J. Donnelly, professor of physics at the University of Oregon, in a book published by Union Carbide. The book, also



Leo Dana in 1926

published as an article in the April 1987 issue of *Physics Today*, describes the work Leo I. Dana, '17, did in cryogenic science and technology.

Dana demonstrated this special instinct, says Donnelly, at Leiden University in Holland in 1922, when he made two of the key measurements that led to identifying the lambda transition in liquid helium, "one of the greatest discoveries of 20th-century physics."

After receiving his bachelor's degree in industrial physics from M.I.T., Dana did research on high-temperature refractories at the U.S. Bureau of Standards in Washington, D.C., then went on to Harvard for graduate work.

His accomplishments during his 40-year career at Union Carbide include insulation leading to the first safe and practical method of distributing liquid oxygen and nitrogen, prestone coolant, the first continuous process for producing large amounts of polyethylene, and lightweight insulation used in Linde Homecare's oxygen walker for respiratory patients.

Dana, who's now 92 and lives in Boca Raton, Fla., gives credit for his successful research to Union Carbide's enabling environment. "Every scientist was allowed some 'freedom money' to pursue research without constraints," he says. "All researchers should have that privilege during some part of their careers." □

panied by a substantial check to the M.I.T. Alumni Fund) from **Arthur Williams**. . . . **Theodore Pierson** writes, "I will soon be 93 and in as good shape as can be expected. Since retirement, we have lived in a very comfortable retirement village called Rossmore." . . . **Lorraine and Stuart Caldwell** included highlights of the past year in their greetings. In March, they had a "splendid vacation" visiting friends in Paradise Valley, Scottsdale. Then in July, they went to London for a short visit, where they "enjoyed perfect weather." They had "a great time and a 'dunking' in history."

Bill Collins for the last five years has been battling a virus that has affected his nervous system. He says, "I have succeeded at being able to get around with a couple of canes, but it is such a chore that I don't believe I'll make it to the 70th reunion." . . . **Eaton Clogher** reports that he is still healthy and sends words of praise and encouragement for my job as class secretary. He sends regards to **Lenny Levine** and **Elie Berman**, as well as the rest of our class. . . . **Charlie Taver** called from Boca Raton, Fla. He and Rhoda are doing fine. Charlie is busy as a bee. He is a director of the Boca Raton bank, a director of the local redevelopment authority, and serves on three committees of the chamber of commerce. Charlie, what do you do in your spare time?

On the sad side is this note from Peggy Marshall recording the passing of **Al O'Donnell**: "I'm writing for my aunt, Inez L. O'Donnell, who is in a nursing home following hip replacement surgery after a fall in mid July 1986. In May 1986, Uncle Al passed away in his sleep. He had ups and downs, as we all do, but had been to a financial analysts meeting just two days before, which he thoroughly enjoyed. This has left a great gap in Inez's life that has been difficult for her. She sends her best wishes."

Finally, with great sadness, I report the passing of **Sumner Wiley** on December 6, 1987. It was our privilege to have shared many happy occasions with the Wileys since graduation.—**Max Seltzer**, Secretary, 865 Central Ave., Needham, MA 02192; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

16

Congratulations to **Caruthers "Dina" Coleman** on his 94th birthday. He writes: "My children celebrated my 94th birthday with a lovely private party of close friends. On the *Delta Queen* trip last year, some lady asked how I managed to arrive at 93 years of age walking so straight up. I told her the straight up was a result of military school and training and the rest was due to good genes, eating and drinking in moderation, and taking no unnecessary exercise—plus a continuing interest in girls. They have named the ballroom at the Lexington Club "The Coleman Room" and the recital hall at Transylvania "The Coleman Hall." I will be remembered in a ballroom and a recital hall at a church-related college. I exchange letters with **John Fairfield** about twice yearly, otherwise I am completely out of touch with surviving members of the class."

Dina, thanks very much for writing. We regret to tell you that **John Fairfield** has left us. His son, Roger, recently wrote us: "It is with great sadness that I report to you the death of my father, age 94, on October 11, 1987, in Troy, N.Y." John was always faithful in his letters and attendance at reunions, and he was a joy to know.

George Crowell pleased us with his Christmas card and this note: "I am still active and go to the office regularly, although my eyes still bother me." . . . **Al Nibecker** recently called from South Pasadena, Calif. He's in his 97th year and doing well. He has arthritis in his hips and has to use a walker. Several of his children are near by and help him tremendously. . . . It's great to get these letters and calls. Keep them coming!—**Bob O'**

Brien, Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

17

From Philadelphia, we have received the sad news that our chemical engineering classmate, **Paul G. Woodward**, passed away last September. Some classmates will recall that he was with American Viscose Corp. for many years in West Virginia and then later in Philadelphia.

Many classmates may remember that **Robert H. Blackall** died years ago—1963, to be exact. M.I.T. has just learned that his widow recently passed away. Bob's will had provided for his widow and other relatives and also for a substantial bequest to M.I.T. With Mrs. Blackall's passing, M.I.T. has been informed that the trust set up in Bob's will has now provided for a gift to the Institute well in excess of \$500,000. His bequest will be used to establish a career development chair in architecture in memory of Bob's father, **Clarence H. Blackall**. This is another demonstration of the loyalty of M.I.T.'s class of 1917.—**Don Severance**, 39 Hampshire Rd., Wellesley Hills, MA 02181

18

As is my usual custom, I sent season's greetings to all of you last December (our members have decreased to 35) and am happy to report the following news received as a result of that mailing. I am saving some of your responses for next issue.

Best wishes arrived from **Herb Larner** and **Ben Greely**, as well as season's greetings (accom-

70th Reunion

19

During the year and holiday season, we were happy to receive greeting cards from **Barbara and Don Way**, **Erma and Doc Flynn**, and **Olive and Bob MacMullin**. They all seemed cheerful, happy, and in a holiday spirit. We also received a group card from the good people at M.I.T. who do such a fine job of putting together the *Technology Review*. Our card was signed personally by each of the personnel in the department. It pleased us very much.

We also received a notice of the death of **Jacob J. Balotin** of Harrisburg, Pa., on August 23, 1986. Notice was received from the executor of Bolotin's estate, who at the time was advising M.I.T. of a donation from our classmate of a generous sum of money. The notice referred to Bolotin as of the Class of 1918, perhaps because of his completing his scholastic requirements in 1918 due to an accelerated schedule like many others at that time. Bolotin was a member of our class of 1919. I shall try to get more information to pass on to you regarding his career.

Best wishes to you all for the summer ahead.—**W.O. Langille**, Secretary, P.O. Box 144, Gladstone, NJ 07934

20

It gladdened my heart to hear from classmates during the Christmas season. From **Agnes and Karl Bean**: Karl says he is holding the fort at 55 Early Redberly Lane in Yarmouth on the Cape. . . . **Barbara and Bill Dewey** are back in Florida and "doing quite well." . . . **Kay and Frank Macconi** have done quite a bit of traveling. Having

seen Frank not too long ago, I can testify that he looks as hale and hearty as ever. . . . Florence and Lee Thomas are enjoying their home in Naples, Fla., and report that they are in good shape. Lee manages to get around the short golf course. Vera Howes, widow of Homer Howes, writes from her new home at 245 Union Blvd., St. Louis. She, too, has been traveling a lot.

Elbridge Wason died on October 19. He was executive secretary for the John P. Chase Corp. Before that, he worked for Aberthaw Construction Co., which was founded by his father. His identical twin Alfred died some years ago. Elbridge was an avid skier and figure skater. He was founder and president of the Newton and Commonwealth figure skating clubs. He was a member of the Boston Skating Club, the Braeburn Country Club, the Waban Neighborhood Club, the Massachusetts Society of Mayflower Descendants, the Needham and Newton Men's Clubs, and the Union Church in Waban. He is survived by his two daughters, a brother, and seven grandchildren. His first daughter, who supplied this information, writes that Alfred's second son and Elbridge's first child were born within four hours of each other, one at the start of the total eclipse of the moon and the other at the end of the eclipse. Make of this what you can. The Bugbee twins were more conservative. Harold was born almost an hour after Perk. At any rate, I am indebted to Barbara Wason Drew for her thoughtful cooperation.—Harold Bugbee, Secretary, 313 Country Club Heights, Woburn, MA 01801

21

Brrr! The thermometer outdoors reads zero this morning. Christmas and New Year's have come and gone. We had a good Christmas and our hope is that you all have a good year.

Christmas letters and cards came in in fair quantity, and I heard from Francis Blewer, Maxine and Carole Clarke, Leo Pelkus, Ruth and Irving Jakobson, Claudia (Mrs. Josiah) Crosby, Betty (Mrs. Norman) Patton, Helga and Jim Parsons, Celia (Mrs. Frank) Huggins, and Dorothy (Mrs. Joseph) Wenick. I hadn't heard from Frank Blewer in years so it was particularly good to hear from him. Frank lives in Manhattan, jogs, swims, and goes to Switzerland every summer with his wife of 60 years. Most of the classmates reported reasonably good health and a little traveling. Ceil Huggins continues to be active in Shell Point Village in Fort Myers, Fla.

I had a phone call after Christmas from Helen St. Laurent who told me that she had recently picked up a virus that laid her low. She was on the mend, and kind friends sent in meals on Christmas. In a phone call to Emma (Mrs. Leon A.) Lloyd I learned that she took a trip to Nova Scotia last year and plans to visit North Carolina relatives this May.

The Alumni Office reports that our well-known classmate Charles A. Breed died on September 30, 1987, in Laconia, N.H. . . . Another obit covers the death of Augustus B. Kinzel on October 23, 1987, in La Jolla, Calif. Gus Kinzel had a most distinguished career. He was former president of the Salk Institute and a world-renowned scientist specializing in metallurgy. He was a member of the boards of several universities and the founding president of the National Academy of Engineering. During his long career, he was president of Union Carbide Research Laboratories. He was credited with revolutionizing the steel industry through development of low alloy steels that were stronger, tougher, and more weldable than those previously known. He held 58 patents and never stopped working on new inventions. During World War II, he was loaned by Union Carbide to the U.S. Government for \$1 a year. He was chief consultant in metallurgy on the Manhattan Project to develop the atom bomb. We salute this eminent classmate.—Sumner Hayward, Secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; Samuel E. Lunden,

Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

Professor T. Alan Hatton was appointed last October to the Class of 1922 Career Development Chair for a two-year term. Professor Hatton is associate professor of chemical engineering. Provost John M. Deutch on announcing the appointment said, "He has demonstrated initiative, commitment, and the ability to deliver educational programs appreciated by the students." An extensive account of Professor Hatton's educational background and his superior accomplishments at M.I.T. appeared in November 18, 1987 issue of *Tech Talk*. It is very satisfying to our class to see that the class funds are being so well used.

A long account of Marjorie Pierce's architectural career appeared in the *Middlesex News* of Framingham, Mass., last October. Since our classmates all know at least generally of her accomplishments, there is no need to retell them here except for a few things perhaps unknown heretofore to many of us. She worked her way through school with a job at the Exeter Street Theatre for \$7.00 a week. She got her master's degree in 1923. Through the 1920s she was in an architectural office but the depression years reduced her to working for a while in Stearns Department Store. Gradually things improved. During the war she was with an engineering company but with that over she finally got back to being an architect doing residential alterations extensively along with many complete buildings. Her black book shows she has been engaged in over 1,600 projects. Retirement is not in sight.

The class officers after telephone conferences have thought it advisable to eliminate all class financial operations. Accordingly, after settling up with the Institute on reunion expenses and paying any other creditors, if any, the balance (in the order of \$3,000) will be paid over to M.I.T. as a final gift of the Class of 1922. Marjorie Pierce will then become Treasurer Emeritus and advisor to the president and secretary who with advancing years and declining skills may need some prodding.

William Cornelius (Bill) Gray, one of our most loyal classmates, died at age 87 last June 25th shortly after attending our 65th. I saw him last when we were both at Andover Alumni Weekend on June 12 and 13. Bill lived and worked in Amesbury, Mass., for his entire life. His company, the Bailey Co., a division of USMC, was acquired some years ago by Emhart Corp. Bill who prepared at Andover came to Tech along with about 20 other members of the Andover class of 1918 among whom were several of our well-remembered classmates; Brod Haskell, Bob Purinton, Ferris Briggs, Bill Roberson, to name a few. Now with the passing of Bill Gray, I think the only remaining Andover 1918 men are Ernie May and your secretary. Our respects are paid to the surviving members of Gray's family—Yardley Chittick, Secretary, Rte. 1, Box 390, Ossipee, NH 03864

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Royal Sterling has turned in to the class treasury \$725 contributed by various classmates toward the expenses of our 65th reunion. He wishes to thank all contributors and to urge others who have not contributed to do so. Thus far, 27 classmates are definitely coming to the reunion, and 14 more are probably coming.

Coming are W. Allis, F. Almquist, S. Berger, Louise Clapp, Phyllis Davenport, L. Dominques, B. Flynn, J. Frank, Elizabeth and Dick Frazier, C.H. Green, H. Green, D. Joy, H. Kalker, O. Koppen, M. Pennybacker, G. Rowen, Sylvasy R. Smith, Mary and Royal Sterling, J. Stratton, and W. Webster.

Royal and Mary now are officially Kentucky

Colonels. They have moved to 2350 Indian Creek Blvd., W. Apt. D201, Vero Beach, FL 32966.

Hugh Chase died May 16, 1987. He graduated with our class in civil engineering and later returned to earn the S.B. and S.M. degrees in geology. He served as a second lieutenant, Corps of Engineers, Reserves. He was a member of the American Society of Civil Engineers, the Georgia Geological Society, Maine Association of Engineers, and Maine M.I.T. Club. His recreation was hiking. . . . Harold L. Townsend died June 3, 1987. He took his S.B. in electrical engineering with our class. He became chief engineer, Oldbury Electrochemical Co., Niagara Falls, N.Y. We have no further information on his career. . . .

Edward Welling died September 30, 1987. He graduated in mechanical engineering. We have no information on his professional career.

David Flesh died May 1, 1982. He studied mining engineering at the University of Missouri then transferred to the institute to continue studies in mining and metallurgy and in geology. He returned to the University of Missouri to seek further information on petroleum geology. He worked with several oil companies. In 1934, he assumed independent status exploring for oil and gas and working out theories of his own. He brought in a major oil and gas discovery from a depth of 6,800 feet in the Glenrose-Rodessa pay zones, also found productive in the Rodessa field 26 miles away in Caddo Parish. He also implemented a large exploration program reaching depths of 12,000 feet in the Cass, Marion, and Harrison Counties of east Texas. He was a certified professional earth scientist and petroleum geologist operating in Texas, Arkansas, and Louisiana. He had been city commissioner, Jefferson, Tex., and president, Chamber of Commerce, Jefferson. During World War II, he served as captain in the air force, operating in African and European theatres. His hobbies were hunting, fishing, travel, and photography.—Richard H. Frazier, Secretary/Treasurer, 7 Summit Ave., Winchester, MA 01890

24

On this extremely cold day of January 9, your scribe returns to his room in Rogerson House from the Deaconess Hospital. The former is an established 100-year-old retirement home in Jamaica Plain, Mass. The hospital catered to a colon polyp removal, originally masked by other symptoms.

Under "Honor Awards," in the November issue of *The American Concrete Institute Journal*, Ed Abdun-Nur, an honorary member of the institute, and consultant in Denver, Colo., has received an award of merit from The American Society for Testing Materials for 50 years of "dedicated effort and significant contributions to the society's technical committees, and his unwavering dedication to the cause of voluntary standardization." Ed focused on the development and standardization of technically sound, quantitative, unbiased specifications for construction materials and processes, and the development of standard test methods.

A note and clipping from John Fitch tells of the death of Winthrop "Wink" Warner in Vero Beach, Fla., November 26, 1987. Wink was in our class as a special student in marine architecture. He was a leader in naval architecture and yacht design and worked around the world with key people in the marine industry. He conducted his own yacht design business in Middleton, Conn., before retirement. He was a past commander of the Vero Beach and Middleton power squadrons.—Russ Ambach, Secretary, Rogerson House, 434 Jamaicaaway, Jamaica Plain, MA 02130, (617) 524-6069

25

These notes were prepared during the holiday season while Cape Cod was digging out from a 12 to 14-inch snow fall. It is the time to acknowl-

edge holiday greetings received from classmates and widows of departed classmates. **Franklin Fricker** and **Marian** wrote from Naples, Florida, as did **Fred Greer** and **Eleanor**. **Ed Kussmaul** and **Adele** checked in from Boynton Beach while **Sam Spiker** and **Elinor** wrote from nearby Brookline, Mass. Also, greetings came from Charlotte Blonsky, Lillian Drew, Frances Stanton, and Virginia Symonds.

Karl Van Tassel was honored on the occasion in October when M.I.T.'s Campaign for the Future was launched. Karl received the Marshall Dalton Bowl Award from the Corporation Development Committee recognizing Extraordinary Efforts in Fund Raising. Congratulations are in order Karl. He and Evelyn spent two weeks in China last fall.

Max King was so kind as to send along with greetings word that in March 1987 a two-day symposium was held on the University of California campus to honor **Dean Morrough P. O'Brien** for his pioneering contributions to education, coastal engineering and consulting with industry.

With sadness the passing of seven classmates must be reported. **Harrison Browning**, a most loyal classmate and M.I.T. alumnus died in a car crash in Spartanburg, S.C., on November 12, 1987. Harrison had been on a trip to Brazil, had stopped in Florida for a short stay and was on his way to Ohio before returning to his home in Tucson, Ariz. For many years he has been the class estate secretary. His father was the founder of the Ohio Gear Co. in Cleveland and Harrison started work there upon graduation and was the owner and president from 1931 to 1963. When Harrison moved to Tucson, he maintained his business interests in Ohio. In 1951, he started Arizona Gear Works in Tucson. He created affiliated firms known as AGM Container Controls Inc. and AGM Electronics Inc. He also was involved in the formation of Abram Airborne Manufacturing and Space Data in Tempe. He was an officer in Tucson Bearing Co. From 1963 to 1965, he was vice-chairman of Towmotor Corp. in Cleveland and played a key role in its purchase by Caterpillar Tractor Co. He received the Silver Beaver award from the Carolina Council of Boy Scouts of America and the Paul Harris Fellow award from the Tucson Rotary Club for his 25 years as a committeeman of the Rotary-sponsored Boy Scout troop. He is survived by a son, a daughter, five grandchildren and ten great-grandchildren. His wife Freda, known to many members of the class, died in 1982.

Thomas M. Lowe, Sr. died at his home in Atlanta, Ga., on September 25, 1986 following a long illness. He received a master's degree from the University of Wisconsin in 1931. He taught engineering at the University of Florida, Auburn University and Louisiana State University. At the time of retirement he was vice-president and chief engineer of Lowe Engineers, Inc. of Atlanta. He is survived by his wife, Grace H. Lowe, a son, a daughter, five grandchildren and three great-grandchildren. . . . **Robert G. King** of Sarasota, Fla., died in Laconia, N.H., on October 4, 1987. He was employed by AT&T in New York state for many years. He is survived by his wife, a son and three grandchildren.

Edward H. Fish died in Ridgewood, N.J., on August 3, 1987. . . . **Elzear N. Gougeon** passed away in St. Laurent, Quebec, Canada on May 2, 1987. . . . **Earl E. Grover** died in Fort Lauderdale sometime in 1985, no date supplied; and **John L. Partin** died on September 6, 1987, in Laguna Hills, Calif.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

would have to be a genius of our time. . . . In a previous issue we reported that **Sally and Charles (Chick) Merrit** had moved to 3030 Park Ave., Bridgeport, Conn., a large and beautiful retirement home. In November, when I was visiting my friend there, I found that Charles is now vice-president of the association. Sally is chairman of the program committee and my friend is treasurer. They seem very happy. . . . **Fanny and Crockett Harrison** sent me their 1987 Christmas Bulletin covering ten folding half pages of pictures of their families and homes. It was tied together by stories of activities, and dialog pulling the families together. A wonderful job. . . . **Howard Humphrey** writes regarding recognition he received for 60 years of Freemasonry service of the Grand Lodge of Delaware.

It is with great sadness that Frances reported the death of her husband **Francis Walsh** of Westfield, N.J., on June 26, 1987. He leaves a son and daughter and four grandchildren. . . . **George Torrens** of Shrewsbury, Mass., died November 2, 1987, leaving his wife, Martha, after their 57th wedding anniversary and their daughter Marianne. . . . **William Callahan** died November 19, 1987, after a short illness. As a geologist and manager of exploration he represented the U.S. in many parts of the world. He was honored by the David C. Jackling Award of the Society of Mining Engineers. . . . **Harvey Abbott** of York, Me., and Ft. Lauderdale, Fla., died October 16, 1987. He leaves his wife, Hazel, three daughters, 11 grandchildren and two great grandchildren. . . . **Frank Cramton's** daughter, Jean, writes that her father passed away September 21, 1987, and his wife, Edith, predeceased him by one week in Jenkintown, Pa. . . . **Robert A. Williamson** of Fairview, Pa., died September 10, 1987, leaving his wife, Phillia. . . . **Donald C. Chase** of Yarmouthport, on the Cape in Mass., died November 5, 1987. Our October notes mention that he remarried after the loss of his first wife. I met his new wife, Margaret, last year as we spent most of the summer at the Cape. Donald was responsible for many beneficial programs, and donated his body to Harvard Medical School. We attended M.I.T. picnics on the Cape. . . . **Charles D. Bathelder** of Winter Park, Fla., died February 20, 1987. . . . **Malcolm S. Hird** of Rockport, Mass., died May 25, 1987, leaving his wife Katherine. . . . We reported previously that **E. Bird Kelly** died February 11, 1987. His wife also passed shortly thereafter, July 21, 1987, also in Nantucket.

I am sure that many of the above classmates had a record of accomplishments, but we had no record sent to us.—**Donald S. Cunningham**, Secretary, 27 Lowell St., Braintree, MA 02184

27

Theodore Ordman of Stanfordville, N.Y., having suffered the bitter blast of the storm of October 4, 1987, has gone to Florida with his wife Val. The catastrophic storm did great damage to their home—the old sugar maple tree fell, along with dogwoods and locust. Ted writes, "No light, no heat, no drinking water for five days after the blast followed by fights with the insurance company! But they are now safe till spring in sunny Masarytown, Fla."

Franklin T. "Hank" Kurt died on October 3, 1987, in South Brooksville, Maine. Author, pilot, and aviation pioneer, he was the first and only recipient of a S.B. degree in aeronautical engineering at M.I.T. in 1927. He had petitioned the faculty to establish Course XVI. Aviation was Hank's profession and his lifelong passion, and his career spanned the industry's most breathtaking epoch of development.

As an undergraduate, he learned to fly and was commissioned as ensign in the U.S. Naval Reserve in 1926. At the age of 23, he designed a three-place biplane, the Kitty Hawk-39. As an instructor of flying, he logged many hours with the legendary aviatrix Amelia Earhart. He also taught Yale boys to fly at the New Haven airport.

Enthusiastic about the future of private flying, he joined with classmate **Bud Gillies** in the Gillies Aviation Corp. in 1936, handling sales, service, and flight operations at the Aviation Country Club, Hicksville, N.Y. During this period, he wrote 50 articles on general aviation, including "The Sportsman Test Pilot" series for the magazine of the same name. But as World War II became imminent, he foresaw the development of military airpower and joined the Grumman Aircraft Engineering Corp., where he headed respectively three departments—mobilization planning, sub-contracting, and quality control.

Although he test-flew Wildcats (Grumman's carrier based fighter planes), his first and greatest love was for amphibious aircraft, particularly Grumman's successful Widgeon, Goose, and Mallard, which he helped design, test, and market.

As a pilot, Hank flew for 42 years, logging 5,000 hours, much of it in amphibians. He writes in his 1974 book, *Water Flying*, "I have flown every mile of coastline from Detroit along both sides of Lake Erie, Lake Ontario, the St. Lawrence River, around the Gaspé Peninsula and both coasts of Nova Scotia. And every mile of the Atlantic coast and the Gulf of Mexico, much of this only a few feet above the surf line." This book, published by MacMillan, combining anecdote and technical wisdom, became a bible for pilots of amphibians from the Caribbean to Alaska.

He was a member of the Society of Experimental Test Pilots and eight other aviation and technical organizations, serving as an officer in many. Hank was a true M.I.T. pioneer! We express our sympathy to his widow, Louise.

Professor **Henry G. Houghton** died on October 21, 1987, in South Dartmouth, Mass. A longtime resident of Wellesley, he was a graduate student in 1927 and became one of the pioneers in modern meteorology and had been a researcher and faculty member at M.I.T. since 1928. He made important contributions in cloud physics and atmosphere radiation, was a founder of the National Center for Atmospheric Research and the first chairman of the University Corp. for Atmospheric Research, which operates the center in Boulder, Colo. He was introduced to meteorology through studies at Round Hill in Dartmouth, where for ten years, 1928-1938, he investigated the physical properties of fog and developed a method to disperse fog by spraying airport runways with calcium chloride from pipes alongside and above the runway. He directed the Round Hill Field Station from the time it was acquired by M.I.T. in 1948 until it was sold in 1964. He was a member of the Department of Meteorology at M.I.T. from the time of its founding in 1941 and was head of the department from 1945 until his retirement in 1970.

In 1940, he received the first Robert M. Losey Award from the Institute of Aeronautical Science for contributions to the science of meteorology as applied to aeronautics. Among other awards and memberships, he was fellow of the American Association for the Advancement of Science, the American Academy of Arts and Science, and the American Geophysical Union.

My dear wife Ruth passed away on December 23, 1987, after a lengthy illness. A family and friends graveside service was given by the Reverend Malcolm Sutherland, who married two of our daughters, Nancy Chase of Epping and Sally Beck of Redlands, Calif. Our third, Jane, takes good care of me in our old family home.—**Joseph C. Burley**, Secretary, RFD, Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, CT 06405

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60th Reunion

With this issue of class notes before you, our big 60th Reunion will be only a few weeks away. If you are still thinking about it, there is still time to act. We hope that you can and will do so. A wonderful five-day program has been prepared, and

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In our November issue of *Tech Review* we had a chance to fill in our knowledge of the worldwide and military developments of **Charles Stark Draper**. For one man to cover the tremendous number of innovative ideas and designs, he

the Institute has done everything possible to make our stay on campus comfortable, interesting, and enjoyable.

To the many of you who sent in year-end holiday greetings and messages: our sincere appreciation and thanks. It is an especially happy time of year for a class secretary.

Ellen and Larry Glassman wrote to say that they, too, had recently (1985) enjoyed a trip to Alaska. Apparently, they covered a great deal of territory by plane, train, small boat, bus (1,200 miles!) and aboard the cruise ship *Island Princess*. In the spring of '87, they took a 27-night cruise on that same ship from Sydney, Australia, to San Francisco, calling at seven ports along the way. They class it as one of the best vacations ever. You will see them in June on campus. . . . Violet and Henry Gunning report that all is well with them. One of their special joys is whale watching from the shore of their Pebble Beach, Calif., home. One frightening event in the past year was a forest fire that started only a mile from their home. They escaped damage, but 32 other homes were burned. Now Henry is devising ways to wet down his roof in case they are ever threatened again.

We are sorry to learn from Jim White that his wife Kay died last March as a consequence of depression and cancer. His loving family of children and grandchildren helped him through the emotional stress. We hope to see him in Cambridge. . . . A card from Novice and Irl "Tex" Sandidge tells us that they are both well, but Irl is still not up to normal. . . . A Christmas card from Louise and Ernie Knight is in the form of a color photograph of their family gathering in Philadelphia for Thanksgiving dinner. Everyone looks well and happy. The Knights still live year-round on Panther Pond in Raymond, Maine. This keeps them both very busy. Yes, you will see them June 1 at M.I.T.

We count Mary and Max Parshall among our very faithful correspondents and staunch supporters of M.I.T. and the Class of '28. At present, health considerations preclude any long distance travel for them. Nevertheless, they are deeply interested in the 60th and will be with us in spirit. They have many friends who visit them and, with Mary driving, they enjoy dining out. Mary continues to play the piano and has a piano class for ten people once a week. On November 11, 1987, the Parshalls observed their 53rd wedding anniversary.

It is with deep regret that we must report the deaths of five classmates: Arthur R. Smith died February 21, 1987. Arthur came to M.I.T. from Dartmouth College and graduated in Course XV, business and engineering administration. His career was in business management and sales for several prominent firms including Owens-Corning Fiberglas Corp. and Sheller-Globe Corp., both in Toledo, Ohio. . . . Montague S. Burgess died September 4, 1987, following eight months of illness. The report came from his daughter Karen. Monty graduated in Course VI-A, electrical engineering, with S.B. and S.M. degrees. His professional career was with the technical staff of AT&T Co. and Bell Telephone Laboratories on design and development assignments. He had four patients to his credit. Upon retirement in 1964 Monty established his own investment management business that continued through his later years. Monty's interests were both broad and in depth, covering music, genealogy, travel, and a variety of hobbies. . . . James E. Ryan died November 21, 1987. We were informed of this in a letter from his wife Elva. Jim graduated in Course VI, electrical engineering, then studied at New York University for a master's degree in business administration. His professional life, until retirement, was with Diehl Manufacturing Co. (Division of Singer Manufacturing Co.) as sales engineer and district manager. Jim and Elva had two daughters, two sons, and grandchildren.

Wilson R. Sherman, captain, U.S. Navy, retired, died November 8, 1987. Wilson studied in Course VI, electrical engineering, then continued

his studies at Northeastern University, Brown, Bowdoin, and Naval Research Labs (radar). Our record shows that his early work in industry was in engineering development. This was followed by his career with the Navy. . . . Ralph F. Tefft died July 9, 1987. Ralph, as a member of our class, earned his Ph.D. in chemistry. Our record shows that he was a research chemist in his earlier years and, more recently, research director for E.T. Trotter & Co., Port Washington, N.Y. . . . We extend our heartfelt sympathy to the families of these deceased classmates.—Walter J. Smith, Secretary, 37 Dix St., Winchester, MA 01890

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I received a number of Christmas cards from our classmates. Bill Bovvie and wife Sally, from Olmstedville, N.Y., writes, "It was nice to see you and Helen at the M.I.T. National Alumni Conference in Cambridge. I hope the 60th reunion meeting went well. Have a nice winter in Florida." . . . Butler King Couper of Tryon, N.C., writes: "You are doing a 'bang up job.' Keep it up. Give my regards to Bill Bovvie when you see him." . . . Joaquin Llanso and wife Dorothy from the Woodlands, Texas: "We have more or less settled down in this small community near Houston. We do miss the many years of foreign travel. We have our daughter and a son nearby, but find it difficult to keep up with our 11 grandchildren and eight great grandchildren living in many parts of our country."

Frank Mead and wife Mary of Northport, Fla., write: "We have been here since October 1987, a little earlier than usual because last summer was very confining. On Memorial Day while Frank was cleaning up a lot we own across the street, a rock shot from under the rotary mower and hit his leg, fracturing a bone. That meant hospitalization, a cast on his leg, crutches, and canes until September. We had to hire help to haul ten lobster traps and take care of a big vegetable and flower garden and, of course, no golfing four or six times a week as before. I am down to 117 pounds from 140. The doctor says no cancer, just the process of getting gracefully old. We can count our blessings and are looking forward to the 60th reunion. Greetings to all."

From George Meyers and wife Barbara of Wyomissing, Pa.: "The Meyers had a busy and eventful year in 1987—filled with happy visits from the children and grandchildren, vacations at Fairlee in May and October, where we enjoyed canoeing on the Chesapeake, tennis, watering the lawn, and doing odd things that needed to be done. Last Christmas we spent with Brad and Ann and their three little girls in Miami. The day before we came home, George and Brad had a lovely day fishing off the Keys. Brad and family were here for Easter weekend, and George III and family came up from Annapolis for church and the rest of the day. Our next adventure was a memorable trip to Glen Lake, Mich., to visit Brad and Ann at her family's summer home. After a pleasant evening visit and overnight with our nephew at Columbus, we got within 30 minutes of Glenn Lake and had a rear end collision. No one was hurt but we experienced complicated delays. Then a batch of tornadoes hit Glen Lake and all surrounding towns—no running water, no electricity, no telephone. No one was hurt, and none of the houses were damaged. It's been a good year with many, many blessings."

An Apology for not Writing

*Just a line to say I'm living,
That I'm not among the dead,
Though I'm getting more forgetful
And mixed up in the head.*

*I got used to my arthritis,
To my dentures I'm resigned,
I can manage my bifocals,
But, God, I miss my mind.*

*So, if it's my turn to write to you,
There's no need for getting sore;
I may think that I have written
And don't want to be a bore.*

*So remember that I love you
and wish that you were near,
But now it's nearly mail time,
So must say, good-bye, m'dear.*

*There I stand beside the mailbox,
With a face so very red;
Instead of mailing you my letter,
I had opened it instead.*

Author unknown

Larry Moses and wife Kay of Sarasota, Fla., write: "We are expecting a family gathering here for Christmas weekend—our daughter, our son, and their families, including a 3-year-old and 9-year-old great-grandsons. I hope I will be up to it, as I have spent over three months in hospitals in 1987. I hope 1988 is better for us and a fine year for you and yours." . . . Richard Pies of San Mateo, Calif., writes, "My sister passed away in September, I am planning to move into a retirement facility in October. Love and warm regards to all." . . . Chung Foy Yee of Guangzhou, China, has retired from a professorship at South China Institute of Technology and has come to the United States to live with his son. He sends all classmates best wishes for a healthy and happy new year.

Professor John Happel of Hastings-on-Hudson, N.Y., was appointed council member of The American Institute of Chemical Engineers for 1988-1990. . . . Donald S. Hersey of East Hartford, Conn., writes, "The main things new with us are the onsets of restrictive chronic ailments that seem to take more of our waking hours to cope with. However, we are still able to enjoy our hobbies and other gentle activities with family and friends. My wife Eleanor is recovering from a broken left arm resulting from a bad fall, and I have been active as housekeeper and cook." . . . Edward R. Godfrey of Huntington, N.Y., writes, "We have a new grandson, born last July 3, and our oldest grandson is 27 years old—quite a spread! Only one grandchild married, alas no 'greats' yet." . . . Warren A. Spofford of Tyler, Tex., has joined our distinguished Octogenarian Club, having just turned 80 years old. He still enjoys good health.

Bill Baumrucker of Marblehead, N.Y., writes, "The years have slowed down my tennis a bit—still twice a week—and made me lazier about gardening, but we are still traveling. We just got back from a great trip, driving from Salzburg to Vienna, then to Budapest ending in Prague, 1,100 miles behind the iron curtain. We took in some operas and concerts. They drive very fast there, but I was able to keep up with them at 160 kph. No one told me that the speed limit in Czechoslovakia is 110 kph, and we got caught driving at 147 kph on radar and paid a fine of \$20. It was well worth the experience. Beautiful scenery in Austria and Hungary."

Eric A. Bianchi of Tequesta, Fla., writes, "We spent August and September at Eastman in New Hampshire and again enjoyed early fall foliage and cool weather. Returned home on October 2 and happily found relatively cool weather. We continue to keep well and busy, for which we are very thankful. We are looking forward to details of our forthcoming 60th reunion." Kindest regards to all classmates—Karnig S. Dinjian, Secretary, P.O. Box 83, Arlington, MA 02174

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One of a class secretary's most gratifying moments occurs when he hears from a classmate for the first time, after many years. This month's "gratifiers" are Barnet "Barney" Rosenthal and

Milton Mezooff.

After graduating with our class in chemical engineering, Barney worked for more than 30 years at Massachusetts' Lawrence Experimental Station, which is concerned with the testing of water and wastewater throughout the state. During the 13 years prior to his retirement in 1973, he was director of the station. Last fall the Lawrence station celebrated its centennial, and as an incident of this celebration Barney received a centennial award citation, which (among other things) notes that he received an M.S. in sanitary engineering from Harvard in 1951, that he "was among the first to study methods for monitoring radioactivity in water supplies and to determine effects of nuclear fallout," and that he served on the faculty of Northeastern University. Because of the close association of M.I.T.'s staff and alumni with the Lawrence station over many years, a centennial award citation was also given to M.I.T. Barney, as former director, was selected to make this presentation, which was accepted by David Marks, the current head of the civil engineering department. Barney and his wife Charlotte now live in a retirement home in Tamarac, Fla.

Milton Mezooff has also retired and lives with his wife Bertha in Providence, R.I. During the past decade he has assisted in the establishment of a local community center "which is being well utilized by all age groups for a wide variety of purposes." He is also involved in "social service activities associated with temple life" and lists as his hobby, somewhat cryptically, the "pursuit of creativity with particular attention to novelty, usefulness, and non-obviousness—the three requirements of modern-day patentability."

In an effort to stimulate more such "gratifying moments," I am listing the names of those who, although presumably still among the living, have so far resisted all requests for information during my 28 secretarial years: Mahlon Bragdon, Harold Brown, Israel Cohen, Sumner Fuller, Jack Jarosh, Frank Noonan, Allen Prescott, Alan Vint. Either a direct or indirect report on any of these men would be appreciated.

Willard Morain reports that he had cancer five years ago and is now in full remission. For many years he has kept in good physical shape by swimming regularly in a YMCA pool. He has now completed 2,000 miles of lap swimming. . . . From brief notations on Alumni Fund envelopes, it appears that Reg Bisson, Ed Giroux, Bill Lochlin, and George Holt are all still mobile and in reasonably good health. George is presently engaged in a "frantic search for some drawings and designs done while working in the Rogers Building" and would appreciate any useful suggestions as to where to look.

Once again we have some downbeat items to report. The comment in last November's column about classmates losing spouses has generated reports of other instances of such losses. At a recent meeting of the M.I.T. Club of Tucson, Ted Riehl reported that Phil Holt lost his wife "Pinky" last September and that Jack Bennett's Ann died in October. Also, Les Steffens writes that his Edith passed away about a year ago.

In addition, we have a note from Lillian Ricks that Jay "Cappy" Ricks died at their Thomasville, N.C., home on September 6. Cappy owned and operated the Ricks Realty Co. in Thomasville, and in recent years he and Lillian had shuttled between North Carolina and a winter home in Lighthouse Point, Fla., where Cappy was president of their condo.—Gordon K. Lister, Secretary, 294-B Heritage Village, Southbury, CT 06488

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As a result of Claude Machen's and Dave Buchanan's deaths, Randy Binner has been elected as our class president. Following is an excerpt from a letter that John Swanton wrote to Randy last November: "Howie Richardson, who was president for many years would be a great one to tell you what it's like. He's still in Connecticut. Ed

Hubbard has been active for many years, especially around the 55th and special fund raising times. Ken Germeshousen is the largest supporter of the Alumni Fund in our class, and his wife Polly efficiently runs our mini-reunions.

Ben Steverman, who ran our 55th, has taken over as treasurer. Things are in good hands, and the class is in pretty good shape financially. Dick Ashenden is my cohort for running the 60th. He had special high marks for you as president. I understand he is a fraternity brother. He and I, with Peggy and Louise, plan to check out near-campus hotels for reunion time. Ed Worden does a great job with class notes; I don't know what we would do without him. I help him out when I can, but chiefly I try to keep up with my class agent job—see that everyone is contacted about the Alumni Fund and I thank all the major givers. The class has about 300 members, and there are more than half who remain active. As we are getting older, we are getting a higher and higher percentage of class membership supporting the Alumni Fund. Alumni support seems to be a tonic for longer life. In summary, all of the classmates listed above think it would be a great advantage to the class if you would take the class president job."

John Hollywood (WISK) of Red Bank, N.J., reports that he talked with Fred Elser (KH6CZ) last November for about 30 minutes over ham radio. Fred's address is 216 Millbrook Rd., Augusta, GA 30707. He wanted to be remembered to his old gang. Fred doesn't have regular "skeds" but is likely to use 14,010 CW when on the air. His wife, Mardy, died last year. Fred talks to his son and says he is well taken care of.

Art Lutz of Arlington, Va., writes to me: "I see your name on the list for the Mississippi boat ride and look forward to seeing you in St. Louis. Alice and I are also planning to go, and we should all have a good time. You probably heard that I had a four-way bypass in May. I have come along nicely but still have to be careful. I walk about two miles every day."

It is with regret that I announce the death of Norman C. Thomas, who passed away on May 9, 1986, and Jaroslaus Oleksiw, who died October 4, 1987. Our sincere condolence to their families.—Edwin S. Worden, Secretary, P.O. Box 1241, Mt. Dora, FL 32757; John Swanton, Assistant Secretary, 27 George St., Newton, MA 02158

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As class secretary for over ten years, I never missed a publication until the November/December 1987 issue. I was keenly disappointed to learn that the material I sent in was lost in the mail! The following notes should have been published in December 1987.

President Don Brookfield conducted an open class meeting in McCormick Hall after our dinner at the 225 Club. He thanked all those who had helped to make the 55th so successful. John Brown, treasurer, gave his report. On January 1, 1987, our class had \$4,579. After all reunion expenses are paid, we expect to have sufficient seed money for the 60th reunion.

The following class officers were elected for a period of five years: John S. Brown, president; Wendall Bearce, Vice-president; Melvin Castleman, Secretary; and William Pearce, Treasurer.

There was considerable interest in having a mini-reunion in two or three years. A questionnaire will be sent to classmates to determine how many could attend and the preferred location—Hawaii, Mississippi, Florida, or Massachusetts.

Bertha and Bob Ingram, Dallas, Tex., were impressed by how much Boston has changed since their last visit. We recalled our experience with our bachelor's thesis done under Professor Warren K. Lewis. Bob is still working, although in the last two years he has slowed down to about 40 hours per week.

L. Marie (Mrs. Nicholas) Rothenthaler came to the reunion and participated in the program because she knew that her late husband would

want her to represent him at this reunion. L. Marie says she is very active in many civic and charitable organizations. She spends a good deal of time with her children and grandchildren. Her activities and her memories give her a feeling of a full life. We hope to see her at our 60th.

I had a long and pleasant talk with Marion and Benjamin Chadwick. They are retired and specialize in traveling to unusual places. Classmates, if you are looking for travel advice, I suggest you contact them.

Manly St. Dennis has finally come through with much information concerning his life's work. I will share this story with you at a later date. For now, I excerpt the following from his letter (in no way could I say it more succinctly or colorfully than Manly):

"If I were to summarize the facts of my existence, I would say that having started off with whatever odds destiny bestowed upon me at birth, I have essentially lived my own life (I have never become an organization man). At all events, I have tried to become what Einstein called "a man of value" rather than a "man of success." (A man of value gives more to the world than he takes therefrom; a man of success does the contrary.) I believe to have succeeded in a most modest way; but, then, is this not the case with practically every M.I.T. man to be a man of value? And I have tried to breathe in as much of the beauty of the world as I could. This is why Savina and I came to Hawaii in 1936 on our honeymoon to live where mountains and sea and sky regale the spectacular with a luxuriant vision of beauty every day. We would never have left, but when the war broke out in Europe in September 1939, I was transferred to Washington. It took us 29 years to return here. When we got the chance, I gave up a most promising career in Washington to become a professor at a university whose standing is the highest in Hawaii. A professorship is the noblest and most rewarding career that a man can pursue: it gives him all the time he needs to develop his potentials and to live a full life. Having become a professor emeritus ten years ago, I spend my time lecturing abroad (having passport and wife, will travel with both). So far we have been invited to Spain, Italy, France, Brazil, Chile, (Mainland) China, Japan. Except in the Orient, I lecture in local tongue, and that may be the reason I get invited. In between lectures, Savina and I visit other parts of the world. So far, we have visited 45 countries. This year it has been Singapore and Bali. Absolutely enchanting. This should prompt you to advise us early about the interim meeting. I understand that the odds favor the Mississippi River excursion. It would be a smash if we all came in costumes of a century ago; the men in garbs of gamblers and the ladies in gowns of dowagers or, if more daring, in dresses of a bewitching character. You have my vote.

The Alumni Association has sent us the following information about our deceased classmates. If I receive any obituary information I will pass it on to you. Charles Dreyer, died May 16, 1987; Edward Harrington, July 5, 1984; James Beam, March 13, 1987; Morris Pose, sometime in 1983; John Walker, October 4, 1972; George Kean, December 28, 1986; and Gaynor Langsdorf, February 25, 1987.—Melvin Castleman, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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55th Reunion

Burt Webster reports that as of last November 29, he had received over 40 positive replies to attend our 55th and about an equal number of maybes. He is at: 297 Holden Wood Rd., Concord, MA 01742, (617) 369-4404. . . . Harry Summer reports from Evanston that he is still working (!), has children on both coasts and four active grandchildren. . . . Phil Cook from Longwood still keeps active by square dancing, play reading, and singing.

Leonard Julian and Doris are well and active.

Doris goes to Bermuda and Florida for bridge tournaments with her sisters, then both to Palm Beach, North Carolina, and (someday) China—when Doris retires.

Westy Westaway has moved from the St. Botolph Club in Boston to Weston Manor, 75 Norumbega Rd., Weston, MA 02193. I'm sure Westy would love to hear from any or all of us. And in case you've forgotten, his real name is Clarence.

The following death notices include several which, so far as we can tell, have not previously been reported: **Bob Taylor**, May 5, 1985; **Ed Marshall**, May 15, 1986; **Prentiss Huddleston**, January 12, 1987; **Felix Vogel**, June 16, 1986 (widow, Mrs. Felix A., 2728 Nottingham, Houston, TX 77005); **Joe Carbonell**, (widow, Mrs. Joseph E., P.O. Box 3691, Greenville, DE 19807); **Dave Van Syckle**, October 23, 1987; **Bob McCormack**, November 21, 1987 (widow, Mrs. Robert L., 203 Fair Way, Longwood, FL 32750).

That's all . . . have a drink to June of '88.—**William B. Klee**, Secretary, P.O. Box 7725, Hilton Head, SC 29938

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I called **Leo Beckwith** today to get confirmation of his marriage last summer which I had heard about from **Bernie Nelson**. Leo and Marilyn were married August 23rd at her home in New Jersey and took a three-week honeymoon trip to Europe. Leo sends his best wishes to all of us for the new year. He and his wife had just played a round of golf in summery weather at Palm Beach.

Roland Hanson sent a note through the Alumni Office from Kingston, N.H., "When I retired from Raytheon Co. in 1977 my wife and I moved to our present home on Kingston Lake," where they have enjoyed gardening and year-round water sports. After the 50th reunion they took a trip to Norway, Sweden and Denmark to celebrate their 45th wedding anniversary and visit Roland's relatives. In May 1987 they had an enjoyable week in Hawaii. He continues, "In July I suffered a stroke from which I am recovering slowly but satisfactorily to the doctors. Our son lives in Acton, Mass., and has two children. He is an engineer with RCA. Our unmarried daughter lives in Woburn, Mass."

Alfred Johnson wrote from Naples, Fla., "My wife and I have recently returned from a three-week trip to Japan and China. This was in connection with a People-to-People Intellectual Property Law Delegation to China. There were 17 patent attorneys in the group together with several wives. We first visited Japan where we met with the Ministry of Justice, and subsequently the Ministry of International Trade and Industry (MITI) and business people. We also took a day sightseeing to Kamakura, Lake Hakone, and Owakidani Valley to see Mt. Fuji, returning by bullet train. As guests of the People's Republic of China we visited the cities of Beijing, Tianjin, Shanghai and Guangzhou. Aside from meeting with the principal legal people in each of the areas and exchanging views, we were taken to the Great Wall, the Forbidden City, and other well-known attractions; walked along crowded streets to visit places of business, taken to plays and shows and in the evening, banquets in each of the cities. Finally we went to Hong Kong for a couple of days. All in all, it was a most interesting trip. We came away with the feeling that the people in China were friendly, cheerful and determined to catch us technologically where they are behind, as fast as possible."

This is a letter from **Walter "Stucky" Stockmayer**, "Sylvia and I are just back from eight weeks in the Far East. On the way there we stopped off in Seattle, the first time either of us had been there. I was a guest professor at Kyoto University for the month of October, following a Toyota-sponsored scientific meeting near Nagoya. No real news (we have four granddaughters and one grandson). Aches and pains increase slowly. Parkinson's Law is unbreakable." He appreciates

the Class Notes! While the subject of grandchildren is here: my son Peter and Maria produced my eighth granddaughter (and no grandsons in the East). I have three granddaughters no grandsons in the West, all daughters of Allan James living in Lake Bay, Wash. That makes another Law that appears to be unbreakable!

George Revell was one of six alumni to receive the George B. Morgan '20 Awards for service to the Educational Council announced last October 24th. His home is in Ottawa, Ontario, and he represents M.I.T. in that general area.

Ben Blocker wrote to tell me of **Percy Ehrlich's** death from cancer on November 21, 1987 as did **Walter Stockmayer**. Stocky wrote that Perc was one of his well-beloved course V mates "a truly gentle and rational man." Ben added that Perc had been a professor of chemistry and math at Mass Bay Community College for the past 20 years. He lived with his wife Anne at 66 Fessenden St., Newtonville, MA 02160. He is survived by Anne and three daughters. . . . Mrs. John P. Cogan wrote to tell of the death of her husband **John Cogan** August 14th. He retired from Exxon Chemical in 1969 with whom he had spent his entire career. They moved to Houston on his retirement and have one son and six grandchildren.

A *Washington Post* article announced the death from cancer of **Richard L. Parli** on October 21st at his home in Arlington, Va. He served in the U.S. Army in North Africa in World War II and moved to the Washington area in 1946. He became an independent real estate appraiser and architect and maintained his practice until his death. Survivors include his wife, Virginia, a daughter and son and four grandchildren. . . . **Robert R. Spaulding** died September 29th in Nokomis, Fla., and is survived by his widow Ann B. . . . **Herbert O. Solibakke** died in November 1987 in Bakersville, N.C., and is survived by his widow. To all the survivors of these former classmates I am extending our deepest sympathy.

To end on a positive note: **Ben Blocker** writes that he and Hadassah are in good health and looking forward to the celebration of their 50th wedding anniversary on February 22, 1988. Ben says, "Our boys are planning a pseudo surprise and big bash!"—**Allan Q. Mowatt**, Secretary, P.O. Box 524, (120 Pont St. #3), Waltham, MA 02154

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We had a bunch of year-end greeting cards, some direct, and others relayed to me by their recipients: from **Dorothy and Henry Johnson**, Jan and **Bob Gillette**, Peg and **Fletcher Thornton**, Ruth and **Henry Lippitt**, **Alice Kimball**, **Natalie Runkel**, and **Peg Reday**. (I hope that more of you will include Pat and/or me on your lists for 1988, and add a note of something that will interest your classmates.) Bob had bypass surgery in September and has resumed looking for a sailboat to replace the one he sold earlier. They spent Christmas with their daughter in California, and it sounds as if an old heart problem has been corrected! . . . The Thorntons celebrated their 50th anniversary in August. . . . The Lippitts continued their work and travel, which for agent Ruth are one and the same, and at times can satisfy her love of skiing. I liked the humor they injected in their annual letter and the quotes of early misguided opinions on the uselessness of great inventions such as the telephone. . . . Alice had a houseful—well, partly anyway—for Christmas: three daughters, two husbands, and a grandson aged 17. . . . Peg Reday wrote a gracious note in response to my tribute to Laddie.

Natalie Runkel enclosed an article which I commend to all classmates and their wives, because, barring a common accident, we are all going to be widowers or widows eventually. At the 40th and 45th reunions, we had the good fortune to witness the spirit with which Natalie has long endured the aftermath of polio. A year ago and only

a few months before Henry's imminent death of cancer, she was asked to address a retirement community group about her upbeat approach to a sad and difficult situation. Her talk was so well received that it has been adapted as an article in a local magazine. She comments on several books dealing with happiness and joy, and her message may be helpful to us as the years take their toll. I called Natalie to thank her and ask permission for this reference, and she agreed to provide a photocopy of the article if you will write to her at 9142 N. Mercer Way, No. 86, Mercer Island, WA 98040. I suggest enclosing a stamped, self-addressed envelope to make it easier for this lovely lady.

Let's give a toast to the lives of **Larry Sharpe** and **Clarence Funk**. Clarence, Course IV, died just before our 50th reunion, but word of it was not received until November 1987. Work in architecture was zilch in 1936, and Clarence stayed at the institute on a graduate scholarship to get his master's. Then he and his father, also an architect, worked together until the latter died. At that point, Clarence took up real estate brokering and was busy at this in Wellesley and Newton Highlands until 1985. His wife remains at 111 Hawthorne Ave., Auburndale, MA 02116, and a daughter and two children are not far away on Cape Cod.

Larry Sharpe died last September 11 at the VA hospital in Tampa, Fla., after three years of dialysis treatment for kidney failure, then saying "enough." Wife Jo wrote to their friends Rhoda and **Bernie Nelson**, '35, of his courage in dealing with pain. Larry started with '35, but was with us after taking a year off and graduated in Course XVI. He was well known for his track activities, Beaver Club, and Scabbard and Blade. Larry went into the navy and rose from ensign to commander, doing much work on development of pilotless aircraft. After the war, he worked with Stark Draper at the Institute for a few years, then went to the corporate engineering staff of Sanders Associates, Nashua, N.H. He retired in the early '70s. Jo continues, for a while, to live at 14614 Turtle Creek Circle, No. 403, Lutz, FL 33549. She has two sisters not far away.

A late-arriving letter from **Walther Mathesius** mentions corresponding with **Stan Johnson** once or twice a year. As you will see in the 50th biographies, Wally had a varied and wide-ranging career in the steel industry. His letter mentions more recent consulting work with interesting (and high-powered) clients such as **Baron Guy de Rothschild** and the U.S. Treasury Department. Guess which was the prompt payer?

Pat and I are now one and one-half years into our secretary assignments. Both of us enjoy the opportunity, and we hope to reach classmates who have not been heard from in recent years. During 1988 and beyond, we plan to mail returnable postcards to verify addresses and solicit items for these Notes. But don't wait to be bugged—scribble a note on any piece of paper and mail it to **Frank Phillips**, Secretary, 901 Los Lovatos, Santa Fe, NM 87501 (505) 988-2745 or **James Patterson**, Assistant Secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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Albert I. Blank, 3521 Ferndell, Sarasota, FL 33580 married Norma in 1947. They have a son and a granddaughter. He was in research and development and then a project manager for facility engineering at Chase Brass and Copper Co., Waterbury, Conn., from 1937 to 1969 and in Cleveland, Ohio from 1969 to 1981. . . . **Phillip Bliss**, 68 Theodore St., Newington, CT 06111, married Ruth in 1940. They have three sons, one daughter, one grandson, and two granddaughters. Phil was with Pratt & Whitney Aircraft, East Hartford, Conn., as a project engineer instrumentation, 1952-81; and Raymond Engineering Lab., Middletown, Conn., as an engineer of electronics

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during the years 1940-1952. He is a fellow of ASTM, life fellow ISA, and was awarded the ISA Standards and Practices Award and the ASTM Award of Merit. His hobbies are travel, home computer, church, engineering standards, and Esperanto. . . . **Charles C. Chase**, 2907 Euclid Avenue, Tampa, Fla., married Dorothy in 1949. He was manager of systems and procedures at Harshaw Chemical Co., Cleveland, Ohio; and manager at Ernst & Ernst, Richmond, Va. He was a member of the Hoover Commission Task Force on Paper Work Management; served as Lt. Col. of Anti Aircraft Artillery 1941-46 and was decorated with the Bronze Star Medal in Croix de Guerre, France; and he was chairman and international president, Systems and Procedures Association 1954-55.

Ed Corea retired in 1978. His last position was claim engineer, U.S. Navy. Daughter Gena's second book *The Mother Machine* was published this year. Ed writes, "Still volunteer at a nursing home, also for Scoot, a non-profit wheel chair carrier. I drive and help maintain seven wheel chair vans, do taxes under the AARP/IRS TCE tax counselors for the elderly, gardening, energy conservation committee, dancing, RSVP volunteer Coordinator. Recently wife Marie, my sister and I flew to Dublin, Ireland, then drove to the west coast for two weeks of enjoying Ireland. Wife Marie's main interest is rug braiding. She has made seven beautiful rugs and is still at it. She is a great ballroom and line dancer. I see or talk with Al Wynot once in a while. We have an interest in a local retirement complex." . . . **George S. DeArment**, 200 N. Main St., Meadville, Pa., retired in 1981 as president, Channellock, Inc. He was declared citizen of the year at his lodge of BPOE. His sports and hobbies are golf, stamp collecting, needlepoint, and engraving. Wife Janet's main interest is the Red Cross Bloodmobile and Hospital Escort Service. They plan on going to Australia and New Zealand this spring. George writes, "We spend winters in Florida at 10A Turtle Creek Dr., Tequesta, FL 33469."

Earl D. Fraser, 2237 Ehrborn Way, Sacramento, CA 95825, married Elizabeth Argento in 1942. His career was spent as planning consultant, Sacramento, Calif.; planning director, County of Sacramento; executive director, redevelopment agency of San Bernardino, Calif.; planning director, Kalamazoo, Mich.; and senior planner, Maryland-National Capitol Park and Planning Commission, Silver Spring, Md. He won an award for the American River Parkway Plan and international recognition for the Metropolitan Airport/Natomas Area Plan. He is an honorary member of the American Institute of Certified Planners and won a distinguished service award from Alpha Phi Omega. He was a trustee of California Planners Foundation and Regional Hospital Planning Council. Earl's hobbies are cross country skiing, Brittany spaniel hunting dogs, numismatics, International Torch Club, SIRS Club, and travel.

Leon A. Menzl, 58 South Saint Andrews Drive, Ormond Beach, Fla. 32074, married Elizabeth (Betty) in 1941. They have two daughters and one granddaughter. He retired as director of manufacturing of Electrolux Corp. Leon also held executive positions with AMF, Inc., Burndy Corp., and Mergenthaler Linotype Co. He was president of the Purchasing Management Association of New York and a member of American Management Association Council. His hobbies are golf, photography, and travel. . . . **Chester K. Nie**, House 25, Lane 750, Yu-Yuan Road, Shanghai, 20050, P.R. of China, wrote Dick Young, "I am most grateful to receive (1) our Class Book, and also a few months ago (2) a cassette copy of "Sounds of M.I.T." and "Music for '37" from you. This reveals the fact that our class officers and the reunion committee members never forget us foreign alumni, who were unable to attend this very memorable reunion due to conflicts with our local affairs. Truly, these two invaluable presents of yours remind me so much with emotion of my good old days in Tech 50 years ago. If convenient, please extend my sincere gratitude to our

M.I.T. Alumni Centre for sending me occasionally free copies of *Tech Review* and other information, keeping me abreast of Tech progress. I have been elected a council member of The Soong Ching Ling Foundation of Shanghai, established in 1986, since the late Mme. Sun Yat-Sen was my cousin." . . . **Yuk Pui Poon (Pun)**, 14E, Block 3, Victoria Centre, Causeway Bay, Hong Kong, is still working as the managing partner, Yukon Trading Co. His hobbies are swimming and walking. Wife Elsie's main interest is being secretary, Women's Service League, St. Paul's Church. During World War II, Poon worked in the First-Aircraft Factory, Kunning as assistant designer. After the war, he founded the Yukon Trading Co. . . . **Joseph J. Sousa**, 20 Walter Lane, Hamden, CT 06514, married Patricia in 1957. He was chief engineer at Motor-Generator Design, Electric Specialty, Stamford, Conn., and chief engineer and vice president engineer, Safety Electric Mfg. Co., Hamden, Conn. His hobbies are hunting, fishing, skiing, computers, and gardening.

Dr. Winslow H. Hartford, Ph.D. '30, wrote, "Seeing **Joe Keithley's** picture in the October 1987 Class of '37 notes reminded me of my experiences with several of your classmates. From 1927 to 1933, I was scoutmaster for a troop including your classmates **Joe Keithley** and **Tom Kinraide**, both patrol leaders, and **Ed Swainson** plus five other M.I.T. men. I doubt any scout troop ever set such a record. In 1932, the troop's traditional back-packing trip to the White Mountains was combined into the Great Eclipse Expedition. Ken-nigott, '33, and Swainson undertook to build an 8-inch reflector with camera attached; the scouts were to build 40-inch cameras using 40-inch focal length spectacle lenses and mailing tubes for the summit of Mt. Washington, where it was proposed to install the group. Tom Kinraide and Joe Keithley participated. When we got there, we weren't allowed on the toll road, so we set up shop in a kindly farmer's field north of Jackson. I applied a correction to the ephemeris with a slide rule, established reception of time signals from WWV, and then came the great day. Just as the shadow made first contact, the clouds began to roll in, but we had a marvelous view of the shadow of totality racing down off the eastern slope of Mt. Washington. Our ephemeris were one second off."

I regret to report the loss of two classmates: **P. Dix Becker**, of Plaster House Rd., Southbury, Conn., died May 29, 1987. He had retired in January as Anchor Fasteners' chief engineer. Since that time, he had served the firm as a consultant. His career with Anchor Fasteners spanned more than 30 years. Besides his wife, Mildred, he leaves two daughters, a son, and eight grandchildren. . . . **Albert A. Woll** of 806 Wiltshire Dr., Evansville, Ind., died December 12, 1987, while on a trip to Boston. A native of New York City, he came to Evansville in 1951 and became active in local public education as well as other civic organizations. He was past president of the Evansville-Vanderburgh School Board, on which he served from 1959 to 1971. He was a member of the Indiana State University board of trustees and was named an honorary member of the board of trustees of University of Southern Indiana by Gov. Robert Orr. His activity in civic organizations included the Vanderburgh County Society for Crippled Children, the YMCA, the Evansville Museum of Arts and Science, and Civic Theatre. He was past president of the Evansville Philharmonic Orchestra and Evansville Rotary International. He owned Woll Enterprises Inc., and was an independent oil producer and farm manager. Surviving are his wife, Sarah; two daughters, and four grandchildren.—**Lester M. Klashman**, Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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50th Reunion

Jim Maguire was awarded the George B. Morgan Award last fall at the Alumni Officer Conference for his sustained excellence in service to the Edu-

cational Council. An award of a different nature was given to **Mead Bradner** by the Boston Chapter of the Appalachian Mountain Club—a Certificate of Appreciation for his service on maintaining trails, notable to the point where he is called "Mr. Trails."

I read an interesting article on **Jimmy Viles** who, after studying chemistry with us, went into professional photography, served as a full commander in the U.S. Navy in World War II, and has developed an exotic garden on a former swamp in Ocean Beach, Fire Island, complete with hibiscus, fig trees, and a host of other plants, many of which have no business surviving in northern climes. Well worth a visit.

Some belated departures to report: **Ralph Werman** passed away last August. Ralph, a resident of Needham and Deerfield Beach, had been in Course IV, and for many years owned the Nuremberg Studios in Boston. He is survived by his wife Betty. . . . **Reed Freeman** passed away November 30. Reed resided in Hyde Park, Mass., and is survived by his wife Elizabeth.

Lastly, **Bill Preece, Jr.**, '71, wrote me to tell of his dad's (**Bill Preece**) death last December 15 at Highland Park, Ill., of a heart attack. Bill, Sr. had worked for Revere Copper & Brass in New Bedford, moving to Highland Park in 1985 after his wife passed away. He was a past president of the M.I.T. Club of S.E. Massachusetts, and had planned to attend our 50th reunion.

As I write these brief obits, it occurs to me that the time is later than you think. If you haven't signed up for the reunion, do it now—it may be your last chance to get together with old friends.—**A.L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Francis Recka retired to Harwichport, Mass., after 35 years with the U.S. Government. One career was with the Coast Guard Auxiliary at Provincetown, listening for radio calls from vessels in distress and participating in searches and rescues.

. . . **Sears Williams** (Olivette, Mo.) writes: "Gail Swan (Dallas, Tex.), **Burky Kleinhofner** (Long Beach, Calif.), and I had dinner at Burky's October 17 with our wives. Connie Kleinhofner cooked a superb dinner. We hope to get together again at our 50th."

* **Win Reed** and **Margaret** write: "We have been busy since we saw you and Hilda two weeks after you moved to your home in Gig Harbor. From there, we drove 1,500 miles south to Lake Mead and Hoover Dam, then across Nevada, Utah, and Colorado to home in St. Louis. Last summer we attended a Rotary convention in Munich. The Munich mayor is son of the famous Field Marshall Rommel, and he told good stories to the convention. Munich taxis are mostly Mercedes. Automobile workers can buy, use, and then sell two cars per year. The cost to workers is 20 percent off German list which is about half of U.S.A. list.

"After Munich we visited Vienna, Venice, Milan, Bologna, Florence, Sienna, and Rome. After return to St. Louis, we took four grandchildren (two 15-year-old boys, a 12-year-old girl, and a 9-year-old boy) on a month's trip to Canada, going out of Newfoundland. They had more fun than they would admit at the time as evidenced by what we heard since. The daily needs of the four centered around whether all meals could be at Burger Kings, would there be a pool and a rec room at our motel that night, and where were we going tomorrow.

"People we know thought we were nuts to undertake such a trip, but we all had fun and learned a lot. The rules are simple. The radio played their junk for a while and then classical music. We didn't know how many different types of modern "music" there are. Actually we got so we could understand and stand some of it!

"In Gig Harbor, you talked about some home projects. Hilda may be pleased to know that after

we got back to St. Louis I put new hardware on one of the outside doors that I promised Margaret 28 years ago. We have lived in this 1904, three-story place going on 30 years, and I hate starting any house project because problems tend to be more than skin deep. . . ."

Manning Morrill and **Connie** traveled through Hawaii and Fiji to New Zealand and Australia. They saw the America's Cup races before returning home to Arlington, Mass. . . . **Bob Touzalin** and **Aletta** write: "We'll start this year's trip to England in March to gain up to five hours' extra daylight at the latitude. Changing travel schedule enabled us to enjoy a visit with **Eugenia** and **Fred Cooke** at their lakeside home in Cross Junction, Va., and some water skiing behind their boat. From there we drove to Salem, Ohio, where we traded reminiscings with **Paul Farwell** and **Marie**."

John Alexander and **Nancy** remodeled their bedroom, Wash., home and celebrated with a trip to Portugal and Spain. They brought back a souvenir of real cork, but no bottle around it. After their return, **Hilda** and I joined them for another performance of some of the Evergreen District's top-flight barbershop and Adelines choruses and quartets.

Seymour Sheinkopf and **Sylvia** enjoy retirement at Burtonsville, Md., and write: "Our 50th class reunion will be held at Chatham Bars Inn on Cape Cod. The work is in great hands with **Bill Wingard** as general chairman and **Jim Barton** as 1939 class gift chairman."

Tony Arias lives most of the time in Madrid, Spain. During a recent visit to his daughter in Everett, Wash., Tony updated us with a few news highlights. After Wooster Academy and M.I.T., Tony returned to sugar growing, milling, and distilling in Cuba. After the confiscations, Tony worked in the U.S. redesigning parts of the Continental air-cooled radial engine and in the Netherlands with AMF at Dordrecht. After settling in Spain, Tony became active in sugar and its processing. Now Tony consults for a Bacardi Rum plant in Malaga and looks forward to our 50th reunion.

The reunion topic brings us to **Jim Barton** and **Mary**, who wedged another full year of travels into their programs packed with Mary's tennis and Jim's duties as oft-re-elected mayor of Hunts Point. Jim leads the 1939 class gift project, and his part is in motion. The ball is now in our court—rather in 412 courts of '39er individuals. It would help for each '39er to think and plan ahead so each can respond promptly when his turn comes.—**Hal Seykota**, Secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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Class Treasurer **Edgar Bernard** culled some statistics from the 1987 Alumni Fund Annual Report. There are 417 active members, about half of whom pay their class dues and contribute to the Alumni Fund. Of these, 35 are Great Dome (\$250 or more) givers; 3 are President's Fund (\$500 or more) donors; 7 are Sustaining Fellows (\$1,000 or more); and 7 are Founding Life members (\$10,000 or more).

A note from **Fredyum Henrickson Jr.** of Syracuse, N.Y., to **Ed Bernard** says, "A heart attack held me back from the 45th. But going strong again, spending half time or more at consulting." From Newton, Mass., **Louis Michelson** writes, "I retired from the presidency of Lion Precision Corp. three years ago. Do skiing (every day in winter), swimming, gardening, bicycling, reading."

We must note two deaths at this time. **Eugene S. West** of Punta Gorda, Belize, Central America passed away on April 25, 1986. . . . **Hans Otto** of North Palm Beach, Fla., died in June 1987. The class extends its sympathies to the families.

Sybil and I recently had lunch with **Rhoda** and **Amos Joel** in Morristown, N.J. Amos retired from Bell Labs a few years ago, but has been busy con-

sulting for them and others, as well as attending conferences worldwide. His hobby is playing the organ, which he does beautifully. The Joels had recently heard from **David "Beano" Goodman**, who is recovering slowly from a hip replacement operations.

William G. Peck of Rockville, Md., sends a note, "Am enjoying my retirement immensely. Am keeping busy by looking after a young man (24) with AIDS, and performing volunteer service at Washington, D.C., Whitman-Walker Clinic."

As has been previously reported, a reservation has been made at the hotel in Mystic, Conn., for our 50th reunion in 1990. It is still too early to send out any direct mail announcements of this event.

Please keep those notes coming in order to keep classmates current on your activities.—**Richard E. Gladstone**, Secretary, 1208 Greendale Ave., Needham, MA -2192 (617) 449-2421

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Zachary P. Abusa writes: "In June I crewed with a friend to sail his 38-foot Pearson from Riviera Beach to West End, Bahamas. We set out at 8:30 p.m. for the 12-hour 'easy trip'. We were using the motor to assist in combatting the Gulf Stream when it conked out around midnight. Two squalls later, we were left with a storm jib and part of our main, not enough to make any headway against that Gulf current—next stop Land's End, England. We turned west and figured we'd bump into the U.S.A. somewhere, which we did after 39 hours of no sleep and some really big waves. I concluded that the boat and I were both too old for the trip. Since then, life has been uneventful." Zack adds, "Don't you get tired of people who always have a topper to your story?" No, no! Your secretary had written about a near miss in the London hurricane.

Now I know, and can feel in my bones, that out there somewhere is a classmate with a hair-raising story waiting to be told. Don't hesitate one minute; sharpen your word processor, or whatever, and mail it. I know you had a close escape in your hot air balloon, put the wrong wax on your skis, or had to drive your mate to the hospital against the traffic on the freeway. Needing all your news,—**Joseph E. Dietzen**, Secretary, Box 790, Cotuit, MA 02635

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45th Reunion

After yielding last month to Feingold and Hoey, I am back with the news. . . . Registration at the October NAC in Cambridge included **Richard Adler**, **Burt Angell**, **Ray Frankel**, **John Jenkins**, **Sam Maloof**, **Kemp Maples**, **Jim McDonough**, **Stan Proctor**, **Bob Rorschach**, **Bill Thurston** and **Bill Vallette**. During that weekend, I went with the McDonoughs on an inspection tour of the reunion sites in Newport. I predict we'll all be pleased.

There are two obituary notices to report, rather belated. **Edward E. Ernst** died February 24, 1980, in Anaheim, Calif. **John O. (Jack) Karstrom, Jr.** passed away August 22, 1986, in Denver. We extend our sympathies to the families of these two classmates.

From the *New York Times* we learn that **Charles C. Gates** resigned last September from the chairmanship of Gates-Learjet Corp., New York. He remains as chairman and CEO of the parent Gates Corp., Denver.

Bud Babcock writes that he retired from Borden, Inc. in January 1986 and a few months later moved from Connecticut to Cape Cod. He occupies his time with sailing, walking, computing and travel. He and Barbara have toured in the U.S., Canada and the Antipodes (look it up).

A Christmas note from **Betty** and **Bud Cruckshank** gives an address in North Fort Myers, Fla. In retirement they have adopted a nomadic lifestyle, rolling around the country in their motor-

home. They golf, sightsee, visit relatives and friends, and avoid cold weather, wherever it may be.

Recovering from a horrendous Christmas ice storm, we in Oklahoma are eagerly looking forward to June and reunion.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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John S. Adams retired from Federal-Mogul Corp., Detroit, Mich., in 1985 and is now living on a small farm in Lancaster County, Pa. . . . **John G. Floden** retired from Kimberly-Clark Corp. in June 1987 and now resides in Doraville, Ga.

Your reunion committee met in Haverhill, Mass., December 10 at the home of Anita and Les Brindis to continue discussion on plans for the 45th. Present were Jane and Lou Demarkles, Ruth and Norm Sebell, Melissa Teixeira, and Jim Baird. Norm's letter with the 45th reunion arrangements should have reached you by the time you read these notes. More information will be forthcoming during the rest of the year. Any thoughts or suggestions on the reunion will always be welcomed.—**Louis Demarkles**, Co-secretary, 53 Maugus Hill Rd., Wellesley, MA 02181

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It is a cold blustery early January day as we pen these Notes. In an effort to work up some enthusiasm, I have been thumbing through our 25th reunion book. My, but we looked younger and hairier back then—particularly in those photos taken in the forties, fifties and sixties!

All too often we have class deaths to report and this issue is no exception. **Lucien R. Vianey** of Fitzwilliam, N.H. died November 9, 1986. Lucien is survived by wife Barbara. . . . On September 20, 1987, **Theodore R. Blakeslee II**, age 65, died in Raleigh, N.C. Ted, a fellow Course XIIIer (there were not too many of us!), had an illustrious teaching career at Trinity College in Hartford. After receiving an M.S. in mechanical engineering from Lehigh in 1952, he worked for Hamilton Standard and Pratt & Whitney, both divisions of United Technologies, before becoming an associate professor of engineering at Trinity College. He retired from teaching in May 1986. Ted is survived by wife Virginia, a daughter Marguerite, a son Ted III, and three grandchildren. . . . **George M. Armstrong, Jr.** of Wyckoff, N.J., died October 15, 1987, after nine months in a coma, following surgery; no other details available.

An interesting November note from **John S. Hawkins** of Biloxi, Miss.: "Visited my old prep school, Taft, in April 1987; I could not have identified my classmates from their yearbook photos! I am completing my 41st year with Ingalls Shipbuilding, where I have grown from structures/naval architecture to nuclear submarine engineering to facilities engineering—and have stayed very happy in the process."

Some time this week or next, Ellen and Jim Brayton should be off on their usual two week ski sojourn with the Fall River Ski Club. Hope you found snow, Jim—and I, too, miss our University Club luncheons.

Today's weather suggests that Fran and I accept Jimmie and Tom Stephenson's "it never snows in Naples, Fla." invitation! Tom has become a student—valetudinarian in his Coast Guard seamanship class! It must be that old Columbia midshipmen school training of 43 years ago.

Nick Mumford advises that he and Carol find life gets fuller and busier as the years go by. 1987 brought two new grandchildren for a total of 17 plus three weddings of children—leaving only one unmarried of their 12. Nick continues with the Episcopal Diocese of Michigan. In his words, it is exciting, frustrating, and ultimately rewarding. Lou and Pete Hickey look forward to an '88 trip to Hawaii, as daughter Lisa and family will

be there for a year. Lou is delighted to have Bill, Pete, and Janet all living in local Essex County!

We received a great Thanksgiving card/picture from Edna and J.J. Strnad; the latter complete with a full head of snow white hair! Son Jeff, still a bachelor, is a law professor at Yale this year. Lyse, age 33, is an eye surgeon, and Nora at 31 is finishing her Ph.D. dissertation. . . . Billie and Al Bowen continue to live in Old Greenwich, Conn. Al still commutes to Manhattan, while Billie continues her dressmaking. Now that daughter Andrea is a landowner in New Sharon, Maine, you no longer have an excuse to avoid a rematch at the bridge table!

George Bickford of Cazenovia, N.Y. advises that he continues to do a little consulting, as does **Tom McNamara** of Quincy. . . . **Charles Patterson** continues to hone his golf game. . . . Libby and Jerry Paterson continue to live on son Tony's farm in Midlothian, Tex., where Libby, aside from working in a Waxahachie giftshop, works with about a dozen horses. Jerry continues to be in the steel business in nearby Dallas. Daughter Liz and husband are in a new home in San Rafael, Calif., while Mark, Donna, and their two continue to live in Lyons, N.Y., midway between Rochester and Syracuse.

We had two nice notes from Mary Trageser and Mary Hoaglund. We continue to be amazed by Mary Hoaglund's energy and interests. Glad you were able to squeeze in a vacation in Italy, Mary!

Chris Boland and I enjoyed the *Campaign for the Future* events at the Institute in last October. Congratulations to Prexy Chris on his appointment to the Alumni Fund Board. Now Chris will be able to put a more meaningful bite on us all. We do not have the space to report on all the Boland activities, only to say they have two '88 weddings, Tom in April and Beth in May. Fran and I look forward to the Boland annual pilgrimage to New Castle in February.—**Clinton H. Springer**, Secretary, P.O. Box 288, New Castle, NH 03854

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Just ending the *gemutlichkeit* season and entering the final year of my servitude in the military/industrial complex, knowing I can bug out at my convenience. Got some nice Christmas cards and notes, giving me at least some "real-time" news for the column. The best deal was an invitation from **Bill Cahill** to drop in on their chateau overlooking Lake Tahoe when we take our California "Grand Tour" in mid-May. Sounds like an offer we can't refuse. . . . **Stu Edgerley's** note from salubrious Miami tells us how he's taking up golf as an adjunct of his retirement. The game's coming along. A surprise note came from **Mario Vinci**, lolling in his condo overlooking sublime Laguna Beach after hanging it up at Aerojet General after 27 years. The "surprise" came because I hadn't heard from him in a couple of years and was afraid he'd gone on one of his global "walkabouts." Everything's O.K., though. He's studying to get his stockbroker and insurance agent licenses in preparation for running his own financial planning show. . . . A card arrived from old V-12 roomie, **Stan Young**, but no message. What's say, Stanley? . . . Found a wonderful note from **Roger Bart**, passed along by the Alumni Office some months ago and mislaid in my stack, telling about his voyage with wife Elaine aboard their motor sailer from Martha's Vineyard to their new winter home on Port Royal Island (S.C.) via the Intercoastal Waterway. Wish I could have joined them.

Browsing through the bio book I came across some unfamiliar names and some very interesting stories. One of them is **Waller Conrad**, whose course XIII studies were sidetracked by a trip to the Fleet, ended with B.A. and M.A. degrees from Yale. After a short stint in industry Waller opted for a career in teaching. After apprenticeship at Shady Hill School in Cambridge and five years at Putney School (Vt.), and another M.A. from Yale (in Conservation), he and wife Doris

established The Mountain School in Vershire, Vt., where they still live. They started the college preparatory school in 1963 with ten students and strong emphasis on ecological principals and self-reliant living. In 1982 they were acquired by Milton Academy and have since been thriving. They remain on the advisory board but find time to restore their vintage (1815) brick cape house, build furniture, moderate the town meeting, chair the planning commission, and to travel. Their dream—somewhat coincident with Roger Bart's—is to rebuild a 1940 *Prudence* sloop and cruise the Atlantic coast from Maine to Florida and the Bahamas. "Possibilities are unlimited!"

I guess I can't get over **Bob Fried** with whom I recall playing mixed doubles at the 35th in Woodstock. Bob, who got his X letters with "us" in February 1946 and a II M.S. in 1947, went on to Columbia for a Ph.D. in corporate planning. Along the way he worked his way up through American Can, formed his own NEW Plastics Co., sold it and went on to Dowling College on Long Island, where he is a senior full professor of business and director of the Dowling Business Institute. Partly in consequence, Bob has received the M.I.T. Lobdell Award and been knighted by the Order of St. John. These, along with other initiatives, have enabled him to do creative work for Dowling as well as for "worldwide projects promoting culture, creativity, and stability in a world of chaos." Bob's dream is to report on projects which "in some small way leave the world of the future a little bit better place" at our 80th Reunion!

Adios, amigos; and peace—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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40th Reunion

Gene Ashley was presented with the George B. Morgan, '20, Award for service to the M.I.T. Educational Council. When Gene was appointed as an Educational Counselor in 1962, he was M.I.T.'s only representative in that section of Vermont. His efforts created a greater awareness of M.I.T. and the need for additional Educational Counselors. In 1984, Burlington was formally declared a region, instead of an outpost, and of course Gene assumed the leadership. His style of communications has consistently received praise, and he has been a real credit to the M.I.T. Educational Council. Gene spent 35 years with General Electric before he retired. He does some consulting and personal travel. He is a trustee of his church and a member of the board of the Y.

Bob Hanpeter owns and operates a business that distributes hydraulic and pneumatic products. He has over 30 lines and has to meet quotas set by the manufacturers. He is in the St. Louis area. . . . **Bob Stern** visited the Khumbu area near Mt. Everest in Nepal. On October 19, 1987, there was a freak snowstorm that limited the plans of his group that was trekking to Kala Pattar overlooking the Everest base camp. He found the trip to be the most exhilarating mountain experience that he ever had. It was a chance to get to know a completely different culture and to share in the life of the Sherpas. He was pleased by the ease of communication with the Sherpas. He was rewarded to see Mt. Everest with his own eyes after 25 years of reading about it. The views of the mountains were better than photos and posters. Camping out for 22 days was not a problem, but the difficulty of the trails was more than he expected.

Bob Sandman, chairman of the 40th Reunion Committee, had committee meetings in November, December, and January. Attending the meetings were **George Clifford**, **Sonny Monosson**, **Graham Sterling**, **Harold Ottobriani**, **Milton Slade**, **Malcolm Reed**, **Herb Lipson**, **Al Seville**, **Dave Finnegan**, **Don Noble**, and yours truly. Progress is being made in publicity, facility reservations, and commitments from M.I.T. faculty for our seminar programs.

Our save-the-date mailing (save October 7, 8,

and 9, 1988) has gone out. Additional publicity about the reunion will be sent out regularly, and pre-reunion cocktail parties are planned in the Boston area. Reservations are made at Walker Memorial for our Saturday night event and in 10-250 for one of the seminar programs. Lester Thurow, dean of the Sloan School, will be speaking at the opening of our weekend.

Dean Thurow writes on the state of the national economy for the *Boston Globe*, and he appears on nationally televised programs regularly. Also a faculty member of the Sloan School, Professor Ed Roberts, who has studied technology based companies that formed around Boston and understands the people responsible for entrepreneurial developments, will be another speaker.

In addition, six meals and one cocktail reception are planned to provide opportunity for classmates to meet with one another during the reunion. Information will be available for campus and Boston touring in small groups or on your own. Optional activities include a pre-reunion gathering at a resort in Vermont and post-reunion foliage tours.

In December members of our class gathered again at Endicott House in Dedham. In addition to the class officers, the following classmates were there, Jean and Jack Juechter, Agness and George Fountas, Ann and Ken Brock, Irene and Stan Shein, Nancy and Don Noble, Anita and Verity Smith, Bob Cowan, '49, Barbara and Malcolm Reed, Lorraine and Stan Abkowitz, Gloria and Herb Lipson, Bernice and George Koster, Joan and Sam Hanna, Gloria and Sonny Monosson, Eleanor and Harold Ottobriani, Jean and Milton Slade, July and Graham Sterling, and Alan Levenson. Also Dorothy Seltzer and Rose Lafrenier joined us. In total, about 40 people enjoyed brunch in the remarkable Endicott House. George Clifford greeted everyone and introduced Denny McNear, who reported on progress for meeting the \$8 million dollar plus goal of our 40th reunion gift. Denny reported that three classmates have funded endowed professorships and that we are well on our way towards meeting our overall reunion gift goal.



Werner Gumpertz

Werner Gumpertz received ASTM's 1987 Walter C. Voss Award. The award was for Werner's contributions to knowledge in the field of roofing technology. Werner helped form Simpson, Gumpertz & Heger, Inc. in 1957. Frank Heger is another founder of the firm. Werner received a degree in civil engineering in 1939 from the Swiss Federal Institute of Technology. He received from M.I.T. his S.B. with our class, a master's degree in 1950, and an advanced graduate degree in 1954. As a consulting engineer, he has studied investigated, analyzed, and designed roofing and its systems.

Two members of the class of 1949 who entered as freshman with our class in June 1945 are Geri (Sapolsky) Kundstadter and John Kundstadter. Geri has made 13 trips to China in connection with several development programs. She is on the board of Yale/China Association and serves on an architectural committee. Her activities include the Beijing Academy of Science and English language training in industrial cities. John and Geri, as well as their four children and two grandchildren, have their home in New York City. John manages the family foundation, which

has supported development projects in China and Africa. He was in Africa in April, but most of his travel is to Boston and Washington. M.I.T. recently awarded the Lobdell Award to John.

John D.C. Little is George M. Bunker Professor of Management Science at M.I.T.'s Sloan School. His daughter Sarah is in a joint M.I.T./Woods Hole doctoral program. She has descended to the ocean floor in *Alvin* to study hydrothermal vents. John's son is an M.I.T. graduate and has started a software firm, which is producing a matrix manipulation package. John's wife Betty is an ex-physicist, and after raising a family she became an archeologist. Recently John was recognized for his contributions and was awarded the Kimball Medal by the Operations Research Society of America.

Graham Sterling attended a meeting at the Gordon Institute, a new college founded and endowed by Bernie Gordon. After a full year of study, students earn a master of engineering management degree. The college has completed the second of four quarters of its first fiscal year. Bernie figures they are 40 percent ahead of where M.I.T. was at the corresponding time in its history, that is, M.I.T. had five students while Gordon Institute has seven. Gordon Institute has five full-time professors and many adjunct professors.

Gordon's program is focused toward a single objective—leadership in product development. Students are sponsored by their employer, and they develop a significant product for their sponsoring firm during the year. Course work supplements the development with applicable principles of physics and math, and humanities classes discuss leadership issues as illustrated in the assigned texts.

Products must be electronic or electromechanical in nature, and must be completed to the point where they can be tested for function. The sponsor owns the product. During the course, leadership is differentiated from management to help the student learn how to achieve innovation.

Bernard "Barney" Devins is in his 14th year of retirement after 40 years with DuPont (He had ten years with DuPont before coming to M.I.T.). At age 76, he can feel himself slowing down and writes that he has stopped chasing girls. He keeps busy maintaining their small house and lawn (leaves!), the car, and going to church on Sundays. He is still active in the U.S. Power Squadron's (USPS) Wilmington squadron and serves proudly as chairman of seamanship. His service in the Pacific in World War II, where his commission was the direct result of the magnificent training USPS gave him, fixed his resolve to spend the rest of his life trying to put back into the squadron what he received from it. Barney still has the most wonderful wife in the world. He writes that people who don't smoke or drink don't really live forever, it just feels that way!

Donald Floyd has returned to Massachusetts after a long absence (June '48). His employer, Raytheon, made it possible. He can't believe how prosperous the Commonwealth has become. Fortunately his hometown, Marblehead, has changed very little.

Nilo Lindgren has served as senior coordinator in the Electric Power Research Institute's benefit assessment program for the past two years. He has worked with the many aspects of technology transfer from various sources to the public utilities that support the Institute. Nilo is a professional author and recently published an article in *Public Utilities Fortnightly*. His article assessed accomplishments of the Electric Power Research Institute.—Marty Billett, Secretary, 16 Greenwood Ave., Barrington, RI 02806

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Most of us will remember, in years to come, where we were and what we were doing on "Black Monday," October 19, 1987, when the Dow-Jones Index dropped 500 points. In my case, however, the day will forever be remembered as

a day to forget because early that morning, even before the stock exchange had opened, I was watching the ceiling pass by overhead as I traveled by stretcher to an operating room in the Massachusetts General Hospital for a long-overdue look at my pancreas. (As matters turned out, I didn't find out for a week about the other thing that happened that day.) Thirty days later, on November 17, the day these notes were due, I went home to a two-month period of recuperation. Now, secretaries aren't supposed to write about themselves and I mention this incident only to explain why I missed last month's issue of the *Review*. Some might say I went to a lot of trouble just to get out of writing these notes. And they'd be right.

Herewith, the news you should have read in February. Ken Prytherch (in Franklin Lakes, N.J.) sends a brief comment: "Thoughts after two years' retirement: Why didn't I do it sooner? It's like every day is Friday night. Best part: knowing that when the Metropolitan Opera runs to midnight, you will not have to crash out of bed to be at work at 0800 hours. Worst part: haven't had time to start my string and tinfoil balls."

And another verbatim note, this time from Bob Steinhart in Springfield, N.J.: "I'm in my 32nd year with IBM and in my 36th year with my wife Roselyn. We became grandparents last March when our daughter in Oakland, Calif., gave birth to a son. Our three sons are living in California, Granada, Spain, and New Jersey. I'm a senior marketing representative and sell to federal agencies in New Jersey."

In October 1986, the Safety and Health Hall of Fame was established to honor individuals who have made outstanding contributions to the field of safety and health. Among the first six hall of fame inductees was the late Bill Haddon, first administrator of the National Highway Traffic Safety Administration. Among many outstanding accomplishments, Bill created the NHTSA "from scratch" in 1966 after President Lyndon B. Johnson asked him to do so.

And now, the news for the April issue.

Ernest Barriere writes that (as of November 5, 1987) he has been retired for seven years and lives in Ellerton, Fla., where he is "still active in community affairs, the M.I.T. Club of South Florida, G.E. Elfunis, and retired officers association." (Secretary's lament: I wish I knew what an Elfun is.) Ernest also keeps fit by playing golf, bicycling, and walking.

Blair Manning says he has "followed through with long-held plans and moved in June to permanent residence in Asheville, N.C." Furthermore, he says, "After 35 years of travel abroad with Caterpillar, we continue to travel widely and frequently on our own. This year, we made our most fascinating trip ever—to the Galapagos Islands."

Dave Hardin is chairman of the Institute for International Development, an organization focused on reducing hunger and poverty in the third world. One of its methods is to start small businesses among the poor in 14 Latin American, Asian, and African countries.

Charlie Banfield writes that he has recently been appointed to the position of program manager, Nuclear Surface Ships Project, at General Dynamics Electric Boat Division in Groton, Conn.

At an October breakfast sponsored by the American Society for Quality Control, Bernard Gordon, chairman and president of Analogic Corp., scolded a gathering of CEOs and senior officers for contributing to a quality problem in this country by not caring enough about what goes on at the nuts and bolts level in their own shops. He said, "I talk to people in factories who think that if 98 percent of the components are in right they are doing a good job." In his own shop, Bernie has a unique cure for this attitude: he prowls the assembly line armed with wire cutters and a mallet. Then, when he finds a defective assembly, guess what. That's right. Bam bam, snip snip. Anything that gets by Bernie's mallet and cutters has gotta be good.



Thomas E. Shepherd, Jr., '50, was one of a score of classmates introduced to the 82 undergraduates who hold Class of 1950 Scholarships for 1987-88 at a Faculty Club dinner late last year. All of the recipients have at least one parent with an M.I.T. degree, and two are following in the footsteps of two generations of alumni.

Few of us would think that Little Rock, Arks., has a harbor, including me, and I was even there once. However, since my visit, one has been created, thanks to the efforts of **Fred Brown**, chairman of the Little Rock Port Authority since 1960 and president of AFCO Steel in that town. The harbor on the Arkansas River, dug at a cost of 4.5 million dollars, measures 320 feet wide, a mile long, and 17 feet deep. It is expected to have a major beneficial impact on the economy of Little Rock.

One of the ways we alumni express our thanks to those who work hard on behalf of the school is to honor them with the Lobdell Award. Two of our classmates were so honored in 1987: **Elda Chisholm**, "for dedicated, committed service to the M.I.T. Club of Palm Beach (Fla.), the Educational Council, and the Alumni Association"; and **John Kunstadter** "For his thoughtful dedicated service to M.I.T., the Alumni Center of New York, the Educational Council, and his class, and for the wide spectrum of his volunteer activities for the Alumni Association."

Last December 15, the 40th reunion committee met once again, this time for a potluck supper at the charming home of **Harry Lambe** in Concord, Mass. Interspersed with the fun and eating, the committee managed to accomplish some business, one item of which was that the off-campus portion of our reunion will be spent at the Blackpoint Inn in Scarborough, Maine. The dates for the occasion are June 8-10, 1989. Carve these numbers over your front door and y'all come. Y'hear.

Sadly, I must report the death of **Kemp B. Reade** on July 7, 1987, at age 63. His wife Suzanne writes: "Kemp died suddenly in England a year after his retirement from Pitney-Bowes in Stamford, Conn. He is survived by his wife, four children, and three grandchildren.—**Fletcher Eaton**, Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

In April, 1987, **Will F. Nicholson, Jr.**, chairman of the board and president, Colorado National Bankshares, Inc., was among the 64 recipients of the M.I.T. Corporate Leadership Award. The award honors alumni whose responsibilities in private industry mark them as exceptional contributors to the continued strength and well-being of the economic system. Three-quarters of M.I.T.'s alumni take positions in industry and business. The Corporation, M.I.T.'s governing body, established the awards in 1976 to recognize distinguished corporate leadership. Since then, more than 325 alumni have received the award. . . . **Herbert D. Limmer** is now a senior energy system analyst with Casazza Schultz & Associates, Inc., in Arlington, Vir. . . . **Albert Rand** is presently president and chief executive officer of Dynamics Research Corp. in Wilmington, Mass.

Peter J. Palmer was honored recently at a retirement dinner held at the M.I.T. Faculty Club. Palmer, formerly deputy associate director of the Charles Stark Draper Laboratory, Inc. in Cambridge, Mass., was involved in research and development programs vital to the national defense, including inertial guidance/navigation systems for missiles, aircraft, spacecraft, and submarines. He also consulted with the U.S. Air Force on many special projects. He has lectured at M.I.T., Boston College, and NATO in Paris.

Professor **Francis F. Lee** of M.I.T.'s Electrical Engineering and Computer Science Department, was among the honored guests at a retirement dinner given to 168 members of the Institute who will retire at the end of the academic year. President Paul E. Gray, '54, was the featured speaker. Senior Vice-President William R. Dickson, '56, was the master of ceremonies, and Vice-President and Associate Provost Kenneth A. Smith, '58, read the roster.

Joseph B. Oppenheim now belongs to the Video Club at Brevard Community College, Melbourne campus, and hopes to take the advanced techniques in the broadcasting class next term. Joe says this should help him in the taping of a religious series done at Cablevision of Florida. He makes his home in Satellite Beach, Fla.

Since retiring February 1, 1986, **Gerry Lessells** and his wife Jo have been traveling full-time throughout the U.S. and Canada, visiting old friends scattered all around, plus countless national and state parks. Despite his full retirement, owing to their nomadic life-style, the American Institute of Chemical Engineers presented him with the 1987 F.J. Van Antwerpen Award. Cited for excellence in process and product development, Lessells was honored for "his untiring efforts to attract minorities and women into the chemical engineering profession and to broaden industrial career opportunities for them." He is the author of 26 technical articles and holds five patents for his innovations.

In October 1987, **Bill Enders** retired after deciding that he had worked long enough. Bill and Jean are preparing to move to their house on Lake Winnepesaukee in New Hampshire. They plan to stay in there for nine months of the year and seek warmer climates for the other three. . . .

Samuel M. Tennant was elected president and chief executive officer of The Aerospace Corp., which provides architect-engineer services for the U.S. Government, principally the Space Division of the Air Force Systems Command. . . . **Richard H. Holmberg** is still busy working on building their young company, Sechan Electronics, Inc., Little, Pa. Dick and his wife have enjoyed meeting other alumni on some of the Quarter Century Club travels. He also enjoys bridge and his two grandchildren—"they're grand when they arrive and grand when they leave!"

Edward L. Friedman is currently serving as chairman of the Department of Electrical Engineering, where he is an associate professor. Last August Edward and his wife Esia became grandparents. Their son Cary received an M.S. in elec-

trical engineering from Columbia University in May, where he served as a graduate teaching assistant.

Claus G. Manasse is a vice president and CFO for ImClone, a startup company located in the Soho section of Manhattan. His son Michael is a sophomore at the Wharton School (University of Pennsylvania), and his daughter Karen is a senior in high school. His wife Eleanor is an interior designer.

Robert B. Leonard retired from the U.S. Geological Survey Water Resources Division in January. He is presently consulting hydrogeologist, specializing in water quality problems. . . . **James M. Lydon**, formerly chief operating officer for Boston Edison Co., retired the latter part of 1987. . . . Effective January 1, your class secretary, **John T. McKenna**, has been named vice-president, technological services, for Eastern Gas & Fuel Associates.

We regret to announce the deaths of **Herbert M. Voss**, September 16, 1987; **Donald A. Young**, June 11, 1987; and **Charles E. Heinrichs**, in March 1987. We extend our condolences to the families of these classmates.—**John T. McKenna**, Secretary, 9 Hawthorne Pl., 10H, Boston, MA 02114

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In November, **John J. Welch** became the assistant secretary of the Air Force for Acquisition and will



John Welch

be responsible for research, development, and acquisition activities. He also is chairman of the F-16 Multinational Fighter Program Steering Committee and the Senior U.S. delegate to the NATO Advisory Group for Aerospace Research and Development. John's career began with the Chance Vought Corp. and later with LTV Aerospace as vice-president in Dallas. After becoming chief scientist with the air force in 1969, he was awarded the Exceptional Civilian Service Award. He returned to LTV Aerospace as senior vice-president. John has held consultant positions with various defense advisory boards, the Defense Systems Management College Board of Visitors, the M.I.T. Educational Council, and the Center for Strategic and International Studies Committees on Technology Transfer and Defense Futures. He and his Patti live in Bethesda, Md. They have a son and three daughters.

From Cahoga Park, Calif., **David Long** sent us word of his recently awarded patent for the design concept for a high altitude, long endurance, unmanned aerodynamic vehicle powered by the reradiation from the Earth's surface and the lower atmosphere. It is capable of flights up to 100,000 feet for durations of more than a year. . . . Still dean of Natural Sciences at the University of Houston, **Roy Weinstein** has become the associate director of the Texas Center for Superconductivity. This is an \$11 million per year research center in the science and engineering of new materials. . . . From EG&G in Massachusetts, **Samuel Rubinovitz** writes that it is hard to believe that his youngest son Robert is finishing his fourth year of graduate school—he's going for his Ph.D. in Economics. Sam proudly points out how far his Course XIV has come since his graduation

in producing three Nobel Prize winners.

A later update to the bulletin I received last month on **Al Roberts** states that Al has joined the corporate staff as senior vice-president of the Mitre Corp. . . . Installed among the 50 new fellows of ASM International is **Henry Hahn**, president of Artech Corp., in Falls Church, Va. He is cited for "outstanding contributions to the development of bio-compatible surgical implants having porous metal coatings capable of permanent fixation in the body by means of bony ingrowth."—**Martin N. Greenfield**, Secretary, 25 Darrell Dr., Randolph, MA 02368

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I found some items gleaned from Christmas cards last year especially pleasing: **Don Grine** has had his first grandchild, a boy; **Sandy Isaacs'** son Daniel is engaged to be married; and **Art Turner's** wife Sally won a blue ribbon for her first ever entry, Strawberry Medley Pie, in a cooking contest at Carlisle's Fourth of July celebration.

Art has also forwarded a long letter of thanks he received as class president from William Jarrold, '89, the most recent recipient of the Class of '52 Scholarship. In his letter Bill recounts his excitement with the varied experiences M.I.T. has brought him. Crew and choral society, famous professors and bright fellow students have combined to make a wonderful education. With time, he admits, he now tends to take some of it for granted. After describing his interest in using analytical approaches to subjects not usually treated analytically, as is done in his major, cognitive science, Bill concludes with the wish to help others someday as he has been helped.

Donald Jaffe applies analytical techniques where they are conventionally applied. He has recently transferred to be department head of the Analytical Technology Department of AT&T Bell Labs, supervising groups at Allentown and Murray Hill. He and his wife Carol have lived in the same house, in Ammaus, Pa., for 22 years. Their five children are grown and on their own.

Last fall, Dr. **Charles Beckmann**, a cardiologist, was looking forward to travelling to New Zealand and Australia for the 16th World Scout Jamboree, in December and January, as South Central U.S.A. chairman for the event. He mentions attending a concert for world scouts at the Sydney Opera House as a high point.

Cliff Herdman has just celebrated 35 years with the Port Authority of New York and New Jersey, where he is now planning the growth of its three airports, work he finds more exciting than ever. He adds, "My daughter was just married—my first trip down the aisle; only three more to go!"

Michael Green and his wife Kristi have opened Biscaya Realty, a real estate office, in St. Augustine, Fla. . . . **Michael Smotrich**, whom I remember as Herman, is now vice-president of operations for Candela Laser. He formerly was vice-president of research and development for Cooper Lasertronics.

The doings of **Burt Richter** as director of SLAC are often news in the local paper where I live. A recent edition carried two stories: one on a five-mile-long linear accelerator for which planning is just beginning, and a second on the Stanford Linear Collider (SLC) now nearing completion. Burt hopes this year the SLC will produce 100 particles of a type identified in the article as the "Z-zero boson," a description that really fired my imagination. Burt's goal is to step up production to 10,000 next year, and to flood the market with 100,000 the year after that, before the competition at CERN can ramp up their production.

I am sorry to report that **James A. Berkstresser** died of cancer February 8, 1987. He was a project director in the Bureau of Construction, Florida Department of General Services. He is survived by his mother.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

53 35th Reunion 54

Reunion time is getting close, and in response to a request last fall from **Dick Lindstrom**, our reunion treasurer, many of our classmates indicated that they were planning or hoping to attend and have sent in their class dues. As the same time, a large number responded to a request for information on what they've been doing recently, and I'll try to cover the comments in this issue and the next.

Clifford E. McLain is doing consulting for a number of companies in such areas as planning and designing of new automated manufacturing facilities. He is also a general partner, director, or associate in at least three firms. . . . **Constantine T. Gradihone** is now retired after working as chief marine engineer at a ship design firm. He does occasional consulting as a marine engineer, but he and his wife Carol (a registered nurse) are primarily just enjoying retirement. At least three other classmates retired recently, but Dick didn't provide their names. One worked for Sandia National Labs and now owns his own business (hazel graphics), the second was designing microwave ovens for Tappan, and the third just plans to travel and have a good time. If you recognize yourselves, please let me know who you are.

Ben Coe has been executive director of the Temporary State Commission on Tug Hill for 14 years and pioneered the use of circuit riders to aid rural towns and villages, including planning for 30,000 new residents because of expansion at Fort Drum. . . . **John Ehrenfeld** just started a new career as "a late-blooming academic at M.I.T." teaching courses, coordinating a new program, and starting a series of policy research projects, all in the area of hazardous waste management. . . . **Frank Morris Anderson** says he's still with Lockheed in the Space Systems Division and is enjoying life in Sunnyvale. . . . On the other hand, **R.E. Storey** retired from Lockheed a year ago and now is enjoying travel, tutoring in a literacy program, and writing articles on travel for the handicapped. . . . **Jack Dunnous** is president of Mr. Hamburger & Sons, but didn't say what the company does. **Col. Ralph H. Sievers, Jr.** retired from the U.S. Army about 11 years ago and is now chief engineer for Science Applications International in McLean, Va. He has five daughters, one son, and a grandson now.

Leonard Ehrman is now vice-president, technology, at Signatron, Inc., where he's worked for 24 years. . . . **Carl I. Swanson** has also been with his current firm, Fenwal, for a long time (20 years), where he is now vice-president, quality, but is looking forward to retirement sometime in the future. . . . While many have or are thinking of retirement, **William Gent** has started his own machine tool business in Tulsa. He also has three grandsons. . . . Another vice-president of technology, but at General Data Comm Industries, Inc. is **Fred Cronin**. . . . **Karl H. Eppe** is president and general manager of Heli-Coil and Pop Fastener Division's Emhart Fastening Systems Group. . . . **G.D. Chandley** is also president of his company, Metal Casing Technology, Inc. . . . We also heard from about 42 others, and will try to include them in future "Notes."

George E. Dausman writes directly that he was appointed deputy assistant secretary of the Army for Procurement last April. . . . **Raymond W. Sauer, Jr.** writes that he was recently named as manager of product safety and reliability for Alcoa, which keeps him on the go. He has one son in business and two others in school.

Sadly, I have learned of the passing of two of our classmates last year, **Warren G. Nelson** and **William J. Burns**. Our condolences to their families.—**W. Haberman**, Secretary, 41 Crestwood Dr., Framingham, MA 01701

Sam Losh is not only vice-president of our class, he is also the Educational Council regional chairman for the Los Angeles area. His outstanding work led to his receiving the George B. Morgan Award for service to the Council at the National Alumni Conference Awards Luncheon at M.I.T. last October. I spoke to him briefly after the luncheon, and I now repeat what I said on behalf of the whole class: "Congratulations, Sam!"

Bill Browder is the editor of *Algebraic Topology and Algebraic K-Theory*, recently published by the Princeton University Press. The book contains the proceedings of a symposium in honor of John C. Moore, held at Princeton in 1983. Bill is professor of mathematics there. . . . **Ray Colucci** has been named executive vice-president at Rascal-Milgo, a unit of the international Rascal group of electronics and security companies. Ray has been with the company since 1975. He has been president of Rascal-Milgo's manufacturing division since 1983, and continues in that position while assuming the expanded responsibilities of the executive vice-presidency. Ray had previously been at General Electric, Bendix and Burroughs. He, his wife Barbara, and their daughter live in Broward County, Fla. . . . **Charles Krakauer** has been elected vice-chairman of the Bowmar Instruments Company in Acton, Mass. He also retains his position as chairman and general manager of the subsidiary, Bowmar/ALI, Inc.

Charles Smith sends word that he had a nice visit recently with Peggy and Dave Howes when they helped them vacate his late mother's home. He reports that Dave agreed to remove a 14-foot sailboat from the cellar where it had rested for over 30 years, and is now working on restoring it. Charles lives in Strafford-Wayne, Pa. . . . **Harry Taylor** writes from Israel that he is lecturing in Technion graduate programs and doing "marketing to DOD." He spent eight weeks in the United States last summer, visiting family and friends. While here, he saw **Sam Losh** and **Joe Scheller**.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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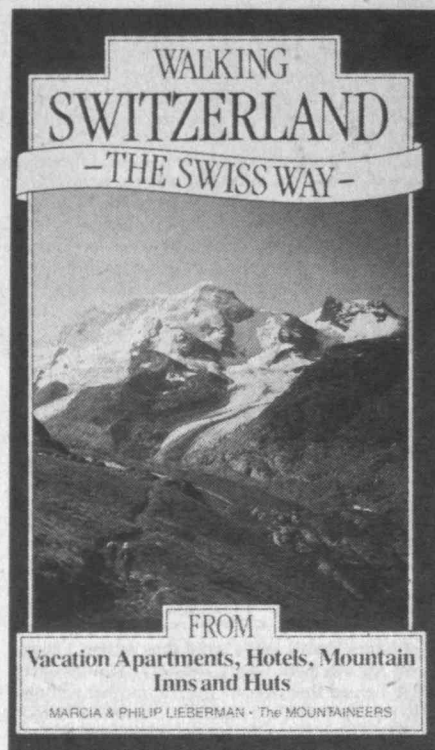
Alloy Computer Products, Inc. of Framingham, Mass., announced a major reorganization, with **Joseph R. Saliba** newly appointed as president



Joseph Saliba

and chief operating officer. Saliba, a 24-year veteran of IBM, where he was one of the team responsible for introducing IBM PC products, had been consulting with Alloy during the prior three months. Just before joining Alloy, he had been president and chief operating officer of Lifeline Systems, Inc. of Watertown Mass.

I met **Dennis Shapiro** at the Wiesner Building during the reception for the kick-off for M.I.T.'s new major fundraising program—the Campaign for the Future. The Wall Street Journal reports that Dennis is now chairman and chief executive offi-



*Swiss hikers do not "camp out"—they rent vacation apartments in mountain centers as a base for day hikes, say Marcia and Philip Lieberman, '56, in their book, Walking Switzerland—The Swiss Way, published by The Mountaineers. They also use buses, trams, trains, and lifts to reach high places and to link different valleys. Experienced hikers themselves, the Liber-
mans provide first-hand information, photos, and maps for over 80 long and short Swiss walking tours. Marcia has authored numerous travel articles, and Philip, currently professor of linguistics and cognitive science at Brown University, has published five books and numerous articles.*

cer at Lifeline Systems, Inc. Denny's wife Susan works for the law firm, Ropes & Gray in Boston. Their three children are Zackary (17), a high school senior; Rachel (19), a Kenyon College sophomore; and Allison (21), a St. John's junior.

John Gahran reports that Gahran and Co. has moved to new offices in Haddonfield, N.J. . . . Colonel **Archie Wood** indicates he has recently directed a study of NASA's Space Station Program by the National Research Council (NRC), at the request of the White House. . . . **Robert C. Seamans, Jr.**, former dean of the M.I.T. School of Engineering, chaired the NRC review committee, and the study was completed last fall.

Congratulations are due to **Donald Steig**, who received the George B. Morgan Award for outstanding service to the M.I.T. Educational Council at the National Alumni Conference awards Luncheon last October. Don was first appointed to the Educational Council in Rochester, N.Y. in 1964. Since then, he has served on the council on Long Island and northern New Jersey, where he was regional chairperson from 1976-1978 and is again since his return in 1982. He was cited as being extremely effective in his communications with his entire council group as well as with other groups in New Jersey.

Fred Lupton underwent his third open-heart surgery last February and is now fully recovered and back to working long hours in project design and value engineering and running the treadmill at 3 1/2 miles per hour up to 14 percent grade. He says they put in better parts this time around, so he is doing fine.

I regret to report that **Ray P. Bartlett, Jr.**, of Winchendon, Mass., died in October. He was a manager and officer of the former family-owned J.H. Davenport & Sons, Inc., executive director of the Winchendon Housing Authority, worked in structural steel sales, and was active in community affairs in Winchendon.

Please keep those cards and letters coming.—

Co-secretaries: **DuWayne J. Peterson, Jr.**, 201 E. 79th St., New York, NY 10021; **Robert P. Greene**, 37 Great Rock Rd., Sherborn, MA 01770

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Henry Eder writes that since September 1986, he has been mayor (alcalde) of the city of Cali, Colombia, which is the third largest city in the country. He says all alumni are welcome to visit him.

Vic Klemas, who is now the director of the Applied Ocean Science Program at the University of Delaware, has been elected to the Space Applications Board of the National Research Council. . . . **Elliot Wolk** is now general partner and director of the Bear Stearns Companies. . . . **Robert Lawrence**, professor and head of the Chemical Engineering Department at the University of Massachusetts at Amherst, has been elected a fellow of the American Institute of Chemical Engineering. . . . **Edward Friedman**, professor of management at Stevens Institute of Technology, has accepted an invitation to serve on the Advisory Committee for Research and Development of the College Entrance Examination Board.

Edward Holtzman reports that the following alumni were at a Labor Day picnic at his house: **Michael Schneider**, **Harry Margulius**, **Mark Alimansky**, '58, and **Richard Glantz**, '58.—**John T. Christian**, Secretary, 23 Fredana Rd., Waban, MA

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Our first item of news this month comes from the Institute itself. Professor **Leon Glicksman**, who received both his bachelor's degree from M.I.T. as well as in 1964 his Ph.D., has been granted permanent tenure there. He's been with M.I.T. since 1966, serving as both staff and faculty member. Leon's research areas have been heat transfer and

fluidization, and the technology of buildings. Now, in the Department of Architecture, he is directing an interdisciplinary program in building technology. Congratulations, Leon. . . . Another honor, this one to **Mark G. Benz**, who is the manager of physical metallurgy for GE in Schenectady. Mark was installed as an ASM fellow during the Society's Materials Week last fall.

Gerald Schroeder writes from Israel, "My wife, five kids, and I live in Jerusalem. Barbara has written a guidebook for families with kids visiting Israel, *Israel Loves Kids, Kids Love Israel*. I have taken a half year off to study in depth modern theories of the cosmos in the light of the book of *Genesis*. . . . And on a sadder note, **Sylvester Minter** writes from Colchester, Vt., "**Joaquin M. Borrero, Jr.** passed away last summer. He was living in Florida. He leaves two grown children, Mark and James, and a wife, Joan. He was my roommate at Baker House. He died of a massive coronary. He was an excellent engineer, father, M.I.T. alumnus and friend."

Let me conclude with news from **Rik Hall** and family gleaned from their Christmas card. Now that they are back in California, Rik and Yolanda miss the wintry seasons and scenery. So much, it appears, that they decided to spend the holidays with the family in England. Son Jeff is attending St. Andrew's University in Scotland; son Rikki, now an M.I.T. alumnus himself, has been traveling the U.S. On this happy note let us wish you the best in this new year and the hope that as you read these words both spring and peace are just around the corner.—**Ron Stone**, Secretary, 116 Highgate Pl., Ithaca, NY 14850, (607) 257-2249

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The University of Lowell reports that classmate **Norman Drucker** has been appointed assistant to the president for planning, budgeting, and accountability. Norm had been assistant inspector general for Massachusetts before taking the Lowell position. Norm's career has included positions as housing program planner for Boston and performance audits director for Massachusetts. Norm, his wife, and two children live in Arlington, Mass.

Those of you who "fly the friendly skies" may have read the October 1987 article in *United Airlines Magazine* telling about (Ivan) **Michael Kasser**, a veteran Ironman. (The Ironman race includes a 2.4 mile ocean swim, a 112-mile bike tour, and a 26.2 mile marathon run.) Mike has been running marathons and other endurance races since 1974. He says, "In 1983 I ran the London Marathon, took the Concorde home, and ran the Boston Marathon the next day." Mike says he has reached his Mecca with competitive running, and with envy for his prowess, I know you join me in wishing him continued success.

Allan J. MacLaren writes from San Jose, Calif., where he is with TRACOR's Advanced Systems Operations. He says that, despite market conditions, his "investments" are doing well—one has graduated from Stanford, one's a senior there, and a third is a sophomore at Claremont McKenna College.

The volunteer trustees of Not-for-Profit-Hospitals has elected **Charles E. McCallum** as chairman of its board of governors. Charles, a partner in the Grand Rapids, Mich., law firm of Warner, Naveross & Judd, is also chairman of the board of Butterworth Health Corp. in Grand Rapids and has served as a trustee of Butterworth Hospital for the past ten years. Charles and his volunteer colleagues work to "bring the concerns of the not-for-profit hospitals sector before Congress."

Edward R. Pallard reports that after 15 years in the semiconductor industry he has gotten into the computer printer business and is the vice-president of Delphak Systems. Although a resident of Toronto, Ontario, he spends half of his spare time in Arizona pursuing his interests in flying and soaring. Like many of us Ed notes that he has "gained weight with age."

A news release from the U.S. House of Representatives Committee on Science, Space, and Technology announced the selection of **Robert F. Stengel** as a member of the Congressional Aeronautical Advisory Committee. Bob is a professor of mechanical and aerospace engineering at Princeton. His current research includes optimal control theory, artificial intelligence, vehicle dynamics, and human factors. Bob has also been associated with The Analytic Sciences Corp., the Draper Laboratory, the air force, and NASA.

My holiday season (I'm writing this during the chill of early January) was enlightened by lunch with **Jerry Kaiz**. Jerry heads his own firm, Industrial Training Corp., specializing in video instruction for repetitive industrial tasks. Jerry and wife Gerri (can be confusing), who have three daughters, live in Rockville, Md.—**Frank A. Tapparo**, Secretary, 15 South Montague St., Arlington, VA 22204

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Received a nice letter from **Eugene F. Finkin** with a news release from Babcock Industries informing us that Gene has been named president of the Materials Handling Group headquartered in Frederick, Md. The Materials Handling Group has annual sales of \$250 million. Gene has had an impressive professional career as an executive with several of the largest U.S. industrial organizations including Allegheny Ludlum, Danly Machine, Blaw Knox, and Westinghouse Electric. He is the author of an important book, *Successful Corporate Turnarounds*, published by Greenwood Press, and writes a regular column on cost reduction and control in the *Journal of Business Strategy*.

Tony Mack writes that the 25th reunion financial situation is still \$765.62 in the black and that he expects to close out the books soon. That will give us a start on the 30th reunion planning expenses. Tony is changing jobs and will relocate to Michigan as manager of corporate development for a small, progressive plastic cup fabricator.

Lane Anderson wrote to Tony from Monaco with the news that he will be on tour in the U.S. with the Monaco Symphony from April 15 to May 2, 1988. They hope to have a concert in Boston (at Jordan Hall) on May 1.

Ruth Nelson writes that she is working as a systems engineering manager for GTE Government Systems in Needham, Mass. Her daughter Diane is a sophomore at Columbia University studying liberal arts. Her son David is 15 and is interested in writing, especially science fiction.

... **L.H. Pitts** writes from San Francisco that he is currently professor and vice-chairman of the Department of Neurosurgery at UCSF. His daughter Jennifer is preparing to enter college, soon to be followed (next year) by his son John.

I talked to **Roger (John) Sullivan** at the 25th reunion. He is now a research manager at the Environmental Research Institute of Michigan (ERIM) in Ann Arbor working on synthetic aperture radar.

... **George Meyer** writes that he is now chief of Hospital Services (vice-commander) at the U.S. Air Force Academy Hospital in Colorado Springs. His son graduated from high school this past year and his daughter is now a junior at Hotchkiss.

M.H. Kaericher writes that he and his family have been back in Brazil since 1984, where he is the finance director for Philo, a Ford subsidiary in the consumer electronics business. Two sons are in college (at Oberlin and Bennington), and two more are in high school in Sao Paulo. ... **John Prussing** writes that two daughters are graduating from college this spring, one from the University of Illinois and the other from Wellesley. His wife Laurel has filed to run for a fourth term as Champaign county auditor.

We received the sad news that classmate **Bertrand B. Bishop** died on October 5, 1987. He is survived by his three brothers—the Reverend John Bishop, Greenwich, Conn.; Bruce Bishop, Kingston, N.Y.; and Terry Bishop, Gutenberg,

N.J.

John M. Cozzolino, Jr., is serving as research director for Insurance Services Office, Inc., and lives in Mendam, N.J. ... **Scott L. Danielson** is working as vice-president for architecture at Parsons Brinckerhoff and is in charge of a professional team building a new \$8 billion rapid transit system in Taipei, Taiwan. His job is to design 70 stations and an urban mall that reflect Chinese culture in contemporary style.

M.I.T. has established the **Edward H. and Joyce Linde** Assistant Professorship in urban Development and selected Professor James R. Richardson as the first holder of the chair. Ed has been quite successful in the field of real estate development. The members of the M.I.T. Class of 1962 are quite proud of Ed's achievements and grateful that he would share his success by establishing an endowed chair at M.I.T.

Yours truly, **Henry N. McCarl**, is also proud that his oldest daughter Kathy graduated magna cum laude from the University of Alabama at Birmingham in 1987, majoring in accounting and computer science. Patricia, my second daughter, will graduate this year from UAB with a major in mathematics and a minor in computer science. She has been active in the honors program at UAB and will attend graduate school to continue her study of mathematics in the fall of 1988. Please send further news of your achievements and those of your family to: **Hank McCarl**, Secretary, P.O. Box 352, Birmingham, AL 35201-0352

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25th Reunion

It's nice for me to be spending a gray New Year's Day reading the warming notes from classmates, and I hope you are as cheered when you read them. For instance, I reported from a press release in the October 1987 issue that **Jon Clemens** had become president of Chronar Corp. I have now gotten a personal note from Jon revealing that Chronar makes photo-voltaic (PV) panels and systems containing them, and sells turnkey PV factories. He tells us he can be reached at RR#1, Box 653, Skillman, NJ 08558. ... **Frank Fradin** reports he is now associate lab director for physical research at Argonne National Lab. He lives at 3418 Maple Leaf Dr., Glenview, IL 60025 with his wife Joan and three sons. He spends much of his time directing a large R&D program on high-temperature superconductors. ... **Gary Feldman**, M.D. lives at 4226 Varsity St., Ventura, CA 93003. Gary focuses on chronic illness and disabilities in children. He has also recently been board certified in medical genetics. He and his wife Ada, a clinical social worker also involved in children's disabilities, have two daughters—Gabrielle, a junior in psychology at Tufts, and Carmia, a freshman (I guess that's what you call one today) in marine biology at U.C. Berkeley.

David Marks, who recently moved to 17 East 16th St., New York, NY 10003, "call(s) on (his) brothers and sisters to help create a new national philosophy based on love, justice and truth rather than ... greed, fear and hatred." I wonder how many of us, reading about insider-trading offenses, presidential and other official lies, and the peccadillos of popular preachers, have not shared the same aspiration. Yet individually we must conduct our daily lives, taking small steps toward better principles of living for all.

One way is the unfettered sharing of scientific knowledge, as practiced by two of our classmates who have published new books. **Jonathan Gross'** ninth book is *Topological Growth Theory*, published by Wiley-Interscience. (He lives at 150 Princeton-Heights Rd., Princeton, NJ 08550.) And Wiley had also published a book by **Ed Dudewicz** (with Satya N. Mishra) called *Modern Mathematical Statistics*. The book addresses theory, applications and computer code. Ed lives at 20 Cross Rd., DeWitt, NY 13224.

A last direct note: **Frederick Prahl** (of 309 Shawnee Dr., Erie, PA 16505) reports he is now manager of two divisions at Skinner Engine,

maker of mixers for rubber and polymers, steam turbines, and steam engines. This is a 119-year-old company, recently bought by Gerald Ryan '57, developing new high-speed, cost-effective steam engines. It's wonderful how engineering can be a mixture of ancient art and contemporary innovation. Perhaps that is part of the charm that attracted many of us to it.

And now our kudos corner: The American Institute of Chemical Engineers reports its Materials Engineering and Sciences award has gone to **Stuart Cooper**, for his contributions in biomaterials, segmented urethanes, and isomers. He has 185 technical publications, is chair of chemical engineering at U. of Wisconsin (Madison), has won many other awards, has held several visiting professorships, and consults with major corporations. Congratulations, Stuart.—**Phil Marcus**, Secretary, 3410 Orange Grove Court, Ellicott City, MD 21043 (please note my new address)

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Happy Spring! There are a handful of Alumni Fund contribution notes to report on this month. Thanks to those of you who contributed and sent news.

Keith Thompson was elected president of the Canadian Society for Chemical Engineering for 1987-88. He is a resident of Pointe Claire, Quebec.

... **David Slosberg** writes from Paris that he is working for BULL, "the French computer company." He is now directing a group defining product architecture strategy in order to improve BULL's customer services. ... **Mickey Rainier** is currently vice-president of computer systems at a small investment analysis firm in New York City ("business is even better after the crash") and is living in Hoboken, N.J. His son Kevin is attending Wesleyan University and his daughter is a high school junior in Burlington, Mass.

Doug Hoylman writes that he took first place in the Long Island Crossword Open. Doug is a resident of Chevy Chase, Md. ... **Jim McGaughy** and some "Georgia Tech buddies" founded GDS Associates, Inc. in Atlanta in 1986. GDS provides engineering and financial consulting services for public utilities. Jim is the vice-president and secretary. His personal data is to the point: "Live in Marietta, Ga.; two sons, 17 and 13; original wife Mary."

There are a few more items which I'll save the next issue.—**Joe Kasper**, Secretary, 3502 Idaho Ave. N.W., Washington, DC 20016

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It's between Christmas and New Year's as I write this, and we're anticipating either a big snowstorm or a near miss for tomorrow. Was meteorology Course XIX? I suspect they didn't have an undergraduate major. You did an undergraduate degree in magic, witchcraft, or alchemy and then took a graduate degree in meteorology. ... You may perceive that the forecasts of recent seasons have not been outstandingly accurate.

A few career news notes from Alumni Fund envelopes have lived up the holiday season. **Paul Newton** writes that after 18 years in Dallas he moved to the San Francisco area to become president of Relational Technology, Inc. The company is at \$60 million plus and growing rapidly. Its product is a data base system called INGRES that runs on all kinds of computers. Paul's sons Michael, 11, and David, 8, like soccer and skiing and are adapting quickly to the California lifestyle. Paul's wife Lilah, a native Texan, is taking a bit longer to adjust. ... From the other coast, **Bernie Nordmann** writes that he is working as a consultant in computer system design and software in Parsippany, N.J. Bernie and wife Anne do downhill and cross-country skiing in the winter, and some hiking and canoeing in the summer.

Phil Smith sold Kupler Corp., an electrical con-

A JOURNEY BEYOND THE BOUNDARIES
OF SPACE TO UNLOCK THE SECRETS OF A LONG-LOST WORLD

THE JULES VERNE OF THE '80s
Charles Sheffield, Author of
The Web Between the Worlds

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We have a great letter from **Paul Rudovsky**, who took time during his vacation in Hawaii to let us know how he's been doing. The last time Paul wrote, he was at CitiBank in New York. Two years ago, he took over his father's business, manufacturing a line of high quality men's trousers. Last May, Paul gave up his bachelor life to marry the former Marcia Oppenheimer. He reports that this has had a positive effect on "all parts of my life except my golf game." It sounds like a worthwhile trade. Paul and Marcia are living in New Rochelle.

Hal Helfand is working as a software systems designer for Actex Information Systems which makes optical disk-based document storage systems. . . . One year ago, **Mario Fiori** was relieved as commander of Submarine Squadron Four and assigned command of the Naval Underwater Systems Center, with headquarters in Newport, R.I.

That's all the news—send me more.—**Jeff Kenton**, Secretary, 7 Hill Top Rd., Weston, MA 02193

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A trip to Hong Kong and Sydney prevented **Stan Rose** from attending our 20th reunion last year. He missed seeing old friends from our class, as he had been looking forward to the reunion. Stan is vice-president at Bankers Trust in New York City, where he leads the Distributed Processing Technical Support group and oversees about 200 MIPS worth of VAX computers. An excellent article, regarding Stan and his role as Bankers Trust's DEC hardware manager, appeared in a June 1987 issue of *Computerworld*; please contact me if you would like a copy. Stan, who has been with the bank ten years, points out (perhaps with a hint of nostalgia) that he is actually eligible to receive a pension.

Speaking of getting older, Stan reports a "feeling old" experience that occurred during a recruiting trip to Cambridge last winter. During his trip, he paid a visit to a friend's daughter who is an M.I.T. freshman living in Baker House. He writes, "Here was the next generation of someone with whom I attended the Institute (class of '64) who was now living where I had lived for four years. And, has Baker House changed! Everything is coed, not just the floors, but even the bathrooms. I think the limit is the rooms!"

Of course Stan also sees time march on in his own home. Stephanie, 14, is already in high school, and Jeffery, 12, is in the seventh grade. The Rose Family lives in Lawrenceville, N.J., which is a 90-minute commute from the Big Apple. As many of you know, Stan has run the New York City alumni fund telethon for several years. They raised over \$24,000 for the Institute last October, and Stan enjoyed the opportunity to speak with several classmates by telephone.

Robert Sitrin has moved to Merck, Sharp and Dohme Research Laboratories in West Point, Pa., where he is director of biochemical process research and development and involved with the development of vaccines and biotechnology products.

Peter Denton reports that his family frequently sees Pam and Joe Levangie and their two children, Jeremy and Ann-Michele, who are doing well. Pam teaches, and Joe is in investment banking.

The Dentons have also visited Kathy and Don Bellenger and their three daughters, Katie, Annie, and Sara, in Maryland.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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April fool's day class notes being done on the last night of Hannukah two days before Christmas! I hope your new year, now a quarter over, is going well. Recently met Professor **Alan Willsky** in

M.I.T. Building 7 rushing off to make last minute preparations for his sabbatical in France.

And now to the notes that come in on paper. . . . **Barry Unger** was given a 1987 Lobbell Award "for his creativity and energy as co-founder of the M.I.T. Enterprise Forum and an IAP course; being a member/chair of the Technology Day Committee; and for his multitude of other contributions to the Alumni Association." . . . **Matthew M. Frackiewicz, Jr.** has been added to the panels of Labor Arbitrators maintained by the American Arbitration Association, the National Mediation Board, and the Pennsylvania Mediation Board. Several of his computer programs have been published in *I.B. Magazine*, a disk based magazine. . . . **Michael Laird** and family have moved back east and are now living in Stamford, Conn. Their second son, Stewart, was born in August.

Mark Braunstein writes, "Still living in Atlanta. Now have two children—Emily, 7, and Fred, 1. My wife Rovenia is a family physician with Maxicare. I still head up National Data Corp.'s Health Care Business." . . . **David A. Frank** is a newly appointed senior vice-president, treasurer, and member of the Operating Committee of Primerica Corp. in Greenwich, Conn. . . . **Michael Underhill** has left Rice University in Houston, where he was the director of the School of Architecture. He has joined the faculty at Iowa State University as chairman of the Department of Architecture, but he still has a professional office in Houston, now called Cisneros Underhill, Architects and Planners.

As for me, I'm staying afloat through the dark of winter. Bumped into the 27th and last New Hampshire Democratic presidential primary candidate to sign up—Irwin Zucker from New Jersey. (Registration fee: \$1,000, no signatures required! Next time, I'm going to run on a space platform.) My wife met Pat Robertson inside a Concord, N.H., supermarket (shopping for votes). They're everywhere! I'm afraid that's all of fame and fortune and trivia this month, folks. See you in May after the snows melt and the politicians fade away from the hills of New Hampshire as they pursue the vote west.—**Eugene F. Mallove**, 183 Woodhill-Hooksett Rd., Bow, NH 03301

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Mark E. Phelps continues to practice patent law in Chicago, but recently moved to a 1872 Victorian house in Naperville with his family. He is using his carpentry, plumbing and electrical skills to remodel. . . . **Anthony Picardi** and his spouse are becoming increasingly enthusiastic sailors. In January they went to Australia to see the America's Cup races and in August they sailed their boat in the North American Championships. Anthony and Jim Bricker sailed in M.I.T.'s Nautical Association Regatta. Anthony is still at Cortex, a software company in Waltham where he is manager of quality programs. . . . **Thomas Caldwell** and Susan have a son, Christopher, born in February. They live in Sylvania, Ohio, and Tom is executive vice-president of operations at Doehler-Jarvis in Toledo. Susan was formerly personnel director of Bowling Green State University. . . . **Michael Bromberg** has finished climbing the 14,000 footers of the Colorado Mountains and continues to do stage lighting and singing for the Sudburt Savoyards. His business "Three Ring Circuits" continues to thrive.

Karen H. Arenson was a recipient of the 1987 Lobbell Award for a broad variety of her service to the M.I.T. Club of Chicago, the Alumni Center of New York, the Alumni Fund, the Educational Council and the Alumni Association. . . . **Stanislav Jakuba** also received a 1987 Lobbell Award for his continued service as a key volunteer in the M.I.T. Club of Hartford, the Connecticut Enterprise Forum and for his warm hospitality to volunteers and the staff of the Alumni Association. . . . The undersigned continues to specialize in litigation and business law in the merged law

Long a fan of Robert Heinlein and Arthur C. Clarke, Thomas R. McDonough, '66, has written his own science fiction novel, *The Architects of Hyperspace*, published by Avon Books last December. McDonough is coordinator of the Search for Extraterrestrial Intelligence program of The Planetary Society, Pasadena, Calif., a 100,000 member pro-space group.

He is also the author of two non-fiction books, one of which received a special citation from NASA (*The Search for Extraterrestrial Intelligence: Listening for Life*).

The public response to *Architects*? Avon sold out in the first two months, and Arthur C. Clarke wrote to him: "Sequel please!"

nector company, in December 1986, after starting it and running it for nine years. Phil, Suzie, and their daughters, ages 16 and 18, then picked up and moved to Santa Barbara to start a new connector company with the same partners. . . . **Jim Hester** is still involved in health care and is now developing an HMO called Pilgrim Health Care in eastern Massachusetts. Jim has a new house in Lexington. The twins are almost 10, and daughter Faith will be approaching 2 years by the time you read this. . . . **Patric Dawe** is still with Albert C. Martin and Associates of Los Angeles, now as director of planning. He continues to work on urban design and planning for public sector and developer clients.

A short column, but not a bad one. Send a note, and you too can join the annals of the glorious class of 1965.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181.

firm. The Covington Bar & Grill has seen a steady increase in business and has had its first New Year's Eve party. I coached the Canterbury Middle School soccer team which ended the season undefeated and the boys are all participating in athletics, music and other activities. Maggie, my spouse, continues to be involved in the practice of law and real estate sales. Thank you for your various letters and cards.—**Robert Vegeler**, Secretary, Beers, Mallers, Backs, Salin & Lamore, 2200 Ft. Wayne Natl. Bank Bldg., Ft. Wayne, IN 46802

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James J. Zilli died on October 26, 1987, as a result of an automobile accident. He was a resident of Ossining, N.Y. and was self employed as a computer programmer.

John M. Vernath is manager of mechanical engineering with Ford, Bacon & Davis. He spends his free time hiking, mountaineering, and in environmental activism. . . . **Malcolm Casadaban** is an associate professor in the Department of Molecular Biology and Molecular Genetics at the University of Chicago. He is married to Joany Chou, a Berkeley graduate. They have a 6-year-old daughter. He recently visited **Robert Rance**, who is married and expecting a child. Robert is still with AT&T Bell Labs.

Herbert G. Noyes serves on the Municipal Budget Committee, Kingston, N.H., and the executive board of the greater Newburyport chapter of the American Red Cross. . . . **Marc P. Kahgan** is now board certified in adult psychiatry and is an assistant clinical associate professor of psychiatry at Tulane Medical School. . . . **Lloyd A. Marks** was recently appointed director of the Cardiovascular Lab at St. Christopher's Hospital for children in Philadelphia, Pa., and is assistant professor of pediatrics (cardiology) and adjunct professor of electrical engineering at Temple University in Philadelphia.

Thomas E. Nelson is vice-president, systems development at Artificial Intelligence Corp. in Waltham, Mass. . . . **Edward M. Donie** has been promoted to European controller for Data General Corp. . . . **Mark S. Oshin** is in his tenth year teaching math at Saddle River Day School and has not played bridge in two years, although he is still playing softball, is a crossword constructor, and the author of the annual NJ High School math contest.—**R. Hal Moorman**, P.O. Box 1808, Brenham, TX 77833

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Carol Epstein writes that she moved to Seattle in July to work for Immunex, a large to mid-sized biotech company. She loves Seattle but had planned to return to Vermont to ski at Christmas. She has a fabulous sounding house with the living room and dining room built on pilings over water with a great view of Mt. Ranier. She would love to hear from any classmates. It sounds like her job is great, developing interleukins and colony stimulating factors with exciting applications, combining all aspects of her training to date.

Kenneth J. Berniker is the father of two children, 8 and 6. He is also assistant chief of the Emergency Department at Kaiser Hospital in Vallejo, Calif. . . . **Daniel Nadler** is a surgical tutor at Pittsburgh Eye and Ear Institute. He is also on the M.I.T. Educational Council and is co-authoring a book on glare disability and contrast sensitivity.

Les Klein and his wife, Dr. Toby Rose, celebrated the arrival of their second son, Solomon, on June 13, 1987. His brother Jonathon is 4. Les is president of Quadrangle Architects in Toronto, which has grown to 35 people. He is involved with a broad range of projects, including hotels, condominiums, retirement homes, historical restorations, a television station, and a \$22 million office building.

Proving that the best way to get news about

THE MUSIC MEN

AN ILLUSTRATED HISTORY
OF BRASS BANDS
IN AMERICA, 1800-1920



The Music Men: An Illustrated History of Brass Bands in America, 1800-1920, written by Margaret and Robert Hazen, '70, explores the evolution of the American band movement from its beginning in the early 19th-century to the end of World War I. The band movement was much more than a popular musical fad, the authors say. Bands reflected what was best in American society—a sense of community, a desire for self-improvement, patriotism, and joy in working together for

the benefit of all.

The Hazen's collection of band ephemera now forms the nucleus of an archive of American band history at the Smithsonian's National Museum of American History.

Robert Hazen is a staff experimental mineralogist at the Geophysical Laboratory in Washington, D.C., and a symphonic trumpeter, while wife Margaret is a professional researcher, librarian, historian, and writer.

someone is to report the wrong news, Lynn Lazer Cohen reports that she and **Seth Cohen** not only were not at the reunion but also they are not moving to California. Sorry, Seth is still at DEC as a project leader in the VAX Core Applications Group. She keeps up with their two terrific kids—Rachel, 9, and Mark, 3. Thanks for the corrections.

Roger Mecca is a specialist in critical care anesthesia at Danbury Hospital and chairman of the Anesthesia Department. . . . **Peter Hwang's** company where he works in California, has just been acquired by Teradyne, so he supposes he'll have to buy an overcoat. . . . **Thomas Eagar** wrote a paper on materials engineering research in Taiwan. Presumably, he had a great time on his trips over there doing his research. . . . **John Kavazanjian** is now the vice-president of International Manufacturing Operations at Data General Corp.

Rumor has it that a number of classmates, including **Bonnie Kellermann**, **Gail Thurmond**, and her husband **Dick Gordon** and kids (Laura, Sara, and Robbie), **John Gunther** and his wife **Stephanie Moorman** and daughter **Helene**, and

Bruce Rummel '71, had a great time at Talbot House over New Year's. . . . **Carliss Baldwin** has been given tenure at the Harvard Business School, where she teaches finance and corporate finance.

My big news is that I have retired and moved to Florida (no state income taxes). I hope to spend the summer in southern France, assuming that the dollar does not become totally valueless. Then I want to do some traveling around the world. It's great down here in the sun, and I have already seen one M.I.T. friend—when David Brown, '69, and Trish Fleming were down in Naples over Christmas.

Call if you come to town, and please send your notes to my new residence.—**Wendy Elaine Erb**, Co-Secretary, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963

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It's now post-Christmas week, but the gifts of news from fellow classmates are a bit on the

Scroogy side. However . . . **Lewis Held** writes of having moved from southern California and nine years as a postdoctoral researcher at UC-Irvine, to be associate professor of Biology at Texas Tech, still investigating the developmental genetics of our old friend *Drosophila*. He'll be there for our 15th reunion. Will you?

Rosalind Waldron has joined a family medicine practice in Waterville, Me. . . . **Kent Sharp** has been at DEC for six months now, living in Acton with a set of children, Stephanie, Brian, Julie and Kevin. . . . The first person I met the first day at M.I.T. nineteen years ago, **Tomas Lozano-Perez**, is congratulated on receiving permanent tenure on the M.I.T. faculty July 1. Tomas is an associate professor specializing in the field of robotics. . . . **Diran Apelian** became a fellow in the American Society of Materials, for research in industrial solidification processing. Diran, who is head of the materials engineering department at Drexel University, was noted also for distinguished teaching in the citation.

Yours ambivalently hit one and nearly hit another in an ever-changing list of lifetime goals this year. The first was a hole-in-one on the 176-yard eleventh hole at the Fauquier Springs Country Club. The second was a 298 game in November; eleven strikes and the twelfth in the pocket but a 7-9 remained. There will be another chance, I keep telling myself. All four of us are now heavily into league bowling; the family that bowls together. . . . well, rhyming isn't on that list. See you in June!—**Robert M.O. Sutton, Sr.**, Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74

Another spring, another sigh of relief. Mother nature hasn't forgotten us. Nor, it seems, have you forgotten me. Thanks to one and all for the loads of mail and news.

At the top of the column this month, **Mike Hassett**. After leaving the banks of the muddy Charles, Mike got his J.D. from Columbia Law School, and his L.L.M. from New York University. Four years of private law practice were followed by six years now as associate counsel with Engelhard and Research-Cottrell corporations. "Most importantly," writes Mike, "I married Ilene Karpf (Barnard, '73, and a fellow law student), and we have two children, 1-year-old twins Matthew and Shannon." Mike would welcome a call from his old ZBT buddies. The Hassetts are living in Scotch Plains, N.J.

Frank Morgan joined the faculty of Williams College this past fall as associate professor of mathematics. . . . A little note from **Sam Pierce** places him in Herndon, Va., after serving five pleasant years in the army in Germany. He says, "The duty is much easier, but the traffic is killing me. Oh, for the autobahns!" . . . In the local Cambridge political news, incumbent **David E. Sullivan** was re-elected to the City Council last November, running first in a field of 19 candidates. . . . **James C. Holland** writes to say his last job was "Malfunction Junction," the interchange between I85 and I285 in Atlanta, and his current job is the Jamestown Bridge over Narragansett Bay. Does Jim perchance build bridges? Inquiring minds want to know.

Larry Segil is a full-time staff physician in intensive care and anesthesia at Michael Reese Hospital in Chicago. He and Deborah have David, Jacob, and Jeanne to call their own. Larry says his M.I.T. background is beginning to become useful in research. He's working with "bizarre mathematical modeling of blood flow." . . . **Leonard Guarente** has been granted tenure on the M.I.T. faculty in biology. . . . And finally, thanks to **Gary Miyashiro** for the note. Gary and Rose Marie and Justin are living in W. Reading, Conn., where Gary is director, finance and administration, for Pitney Bowes Business Services.

Happy trails.—**Lionel Goulet**, Secretary, 115 Albermarle Rd., Waltham, MA 02154-8133

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George Gerpheide received his Ph.D. in computer science in 1981 from the University of Utah. He's currently developing alternative input technologies for personal computers. George was planning to launch a start up company based on these technologies in 1987. Here's hoping George's plan worked out. . . . **Elliot Feit** works at IBM in Poughkeepsie, N.Y., doing computer performance analysis and statistical consulting. In addition, he is an adjunct professor of mathematics at Marist College.

Donald Shobrys writes, "The company I am with, Chesapeake Decision Science, has grown from three people to 20, and we are starting to do work in Europe. We provide software and consulting for production planning and scheduling." Don and his wife, Carol Aronson, celebrated their tenth wedding anniversary this past August. Carol recently co-authored an article in hydro-carbon processing. Don saw **Bob Dickson** this past September. As for leisure time, Don still runs, does some bicycling, and was looking forward to doing some winter skiing when he wrote.

I received a copy of **Roger White's** 1987 year-end family newsletter. Roger, wife Sue, and children—Altair, Heather, Adrienne, and Roger III—are alive and well in Salt Lake City. Roger is manager of Novell's Strategic Reports Group. He writes articles, video scripts, and lectures about LANs (Local Area Networks). The family had what sounds like a great vacation in the Bahamas this past November.

And in the legal corner, we have news from all over the country. . . . **Daniel Ganti** became a member of the law firm of Fish & Neave in New York as of the first of the year. . . . I received an announcement from Barnett, Brown, Reed, Hammond & Mintz in New Orleans that **Alan Katz** had become associated with the firm in November of last year. . . . And from Anchorage, Alaska, **Cliff Cantor** writes, "After living in rural Alaska for a number of years, I went to law school up the street from M.I.T. I graduated this June and now am working for one year as a law clerk at the Alaska Supreme Court. My wife Pauline and I have a 4-year-old and 2-year-old twins. Twice in the last couple weeks, we've had bull moose in our backyard—in the city!" Let's hope they don't have animus revertendi.

And more congratulations for another partner, this time at Coopers & Lybrand in Boston. **Douglas F. Newman** was named a partner of C&L as of October 1987. He joined the firm in 1978. Doug specializes in providing tax services to high technology, retail, and international clients. After M.I.T., he received a J.D. (1978) and L.L.M. (1983) in taxation from Boston University School of Law. He and his wife Suzanne and son Jeffrey live in Cambridge.

And congratulations are in order for a tenured professor among us. **Jeffrey Lang** was granted permanent tenure on the M.I.T. faculty, Department of Electrical Engineering and Computer Science, effective last July. According to an article from *Tech Talk*, Jeff is known for his skill in analyzing and designing electromechanical actuators and sensors and in designing advanced control and estimation systems for them.

Babies, babies, babies. According to something forwarded to me entitled "Gossip" (so I hope the following is true), **Holli Jones-White** and Major White are the proud parents of a son, Mark Major White, their first child, born August 6 in Boston. . . . **Bernard Robinson** and wife Tonya had a seven-pound, four-ounce baby boy last April 27, Marcus Bakari Robinson. . . . And although her babies aren't really babies anymore, **Joyce Lerner Demain** and husband Chris, '74, deserve belated congratulations on their fine family, "My three sons," as Joyce calls them. She writes, "Brian is 10 1/2, with a very mathematical mind—perfect M.I.T. material. Seth is 8 and also loves math and science. Ross is three. I have been staying home with the boys helping in the schools and in chari-

table organizations. I guess I'm temporarily retired." Chris works for Martin Marietta Corp. in the Washington, D.C., area as director of business management for FTS 2000. Joyce and Chris are more or less neighbors in Rockville, Md., to **Rich Barron** and his wife Carol, whom they see fairly often. They also discovered that classmate **Alex Pankow** lived right down the street from them but has since moved away. That ol' Pi Lam party animal gathers no moss!

All right now, let's hear from some more of you. Send those cards and letters to: **Jennifer Gordon**, Secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036

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We have some news via the mails. However, we could use a lot more. **Fred Hutchinson** is the founder and president of F.H. Hutchinson & Co., since 1981 a public and government affairs consulting firm, specializing in energy and natural resource policy issues. He married the former Karen Bachtell (November 17, 1979), a 1977 graduate of Georgetown University, and their first child, William H. Hutchinson III, was born July 9, 1987. . . . From **Rick Jamison**: "I am now a lieutenant commander in the U.S. Navy. I have recently completed supervising the overhaul of a nuclear submarine, the U.S.S. *Cincinnati* (USN 693). It has been the only submarine of its class to finish within budget. It was \$2 million under. My wife, Beverly Ross Jamison '75, is pursuing a Ph.D. in computational mathematics at Old Dominion University, Norfolk, Va. Our daughter, Ruth (age 9), is doing a computer programming project for 5th grade!" . . . **Kenneth Davis** sends word that he and his wife, Ellen Radin, are expecting their first child. He is still in private practice (pediatrics) in Elizabeth, N.J.

Ed Crawley has been granted tenure by the "Tute. He is a professor in the Department of Aeronautics and Astronautics, specializing in the vibration and damping of composite materials, vibration and aerodynamic damping of turbomachine rotors, and the dynamics and control of structures in zero gravity. He also has been involved in M.I.T.'s human powered aircraft projects, starting with BURD when he was an undergrad. Among the awards he has accumulated, in 1985 he was named a Young Presidential Investigator, an honor given to outstanding young teachers by the National Science Foundation. Our congrats.

Reginald Smart is now working for Rohm and Haas in Spring House, Pa., and is living in Hershams, Pa. . . . From **Steven Lubar**: "I am now curator of engineering and history at the Smithsonian's National Museum of American History. My main interest is 19th century manufacturing, but I find myself moving more and more into the 20th century, building the museum's collection of robots. I was curator for 'Engines of Change,' an exhibit on the Industrial Revolution, and am now at work on an exhibit on the 'Information Revolution.' . . . Am enjoying life in a log cabin in the small town of Barnesville, MD., with wife Lisa Thoele and dog Grendel."

Barbara Donohue writes: "I'm still at DEC (presently Northboro, Mass.), still living in Acton, doing some writing, some teaching (adult education), singing some musical theatre on occasion, and even doing some engineering at work. Big events this year (1987) have been son (Colin) graduating from high school, my debut this summer as a rock 'n roll singer, and taking my age and gender bracket at the town track meet in shotgun and discus. (Everybody should take up a field event or two when they reach middle age.) . . . I scarcely ever see anything in there (class notes) about people I knew in school, and thought that my writing might encourage someone else to do the same."

Please follow Barbara's request, and write. We can always use the news. As for your secretary, he has moved his office to larger quarters right

around the corner. The phone number will stay the same. I have been asked over the phone and in letters to comment about the Crash of 1987. I was involved in it in real time. It was an amazing phenomenon, with a certain amount of recent historical precedence. I had already experienced the great gold and silver bull and bear markets, so I was not particularly surprised at its violence, or the violent rebound on October 20, 1987, one day later. Neither my firm nor myself were hurt in the crash or its aftermath. This was no small feat. I must confess that there was a certain terrible beauty in watching the stock market, as defined by the S&P 500 futures, go into free fall. As to whether it is a once in a lifetime event, we will see. I hope none of you were hurt in the crash. While we are waiting to see if history repeats itself, please write.—**Arthur J. Carp**, Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960

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Happy spring, classmates! Let's get right to the mail bags. **Darryl Jordan** has been very busy in Anchorage, where he was recently appointed by the governor to the five-member Alaska Historical Commission. He's been recognized in both *Who's Who in the West* and *Who's Who in Emerging America*. Darryl survived an attempted recall of the entire school board due to declining revenues. His daughter, Lily Ann, was born last April 25. . . . **Sarkis Koltoukian** reports that he has at last moved to a house in Cedar Falls, Iowa, which is larger than a garage. He and his wife Ruth had a son, Aram Zaven, on their second wedding anniversary, November 17, 1986. Sarkis still works for John Deere and was fortunate enough to go to mainland China for a month on business in October 1986. He occasionally sees Brye Davis, '76, and Whit Halstead, '78.

Christopher Barnett is currently technical manager on the staff of the executive director of the Massachusetts Water Resources Authority. He and his wife, Elizabeth De Mille-Barnett, have been married for four-and-a-half years, and they have a two-year-old boy, Alexander. Elizabeth is a Ph.D. candidate at the Institute in urban studies. They live in Somerville.

James Hubbard married Adrienne Wilson on September 5, 1987, in Jenkintown, Pa. **Melvin Brown** was a member of the wedding party.

Paul Ackman had a wonderful summer in Mexico and Guatemala and was planning to next visit Hawaii, Australia, Papua New Guinea, New Zealand, the Cook Islands, and Fiji. All you world travellers out there are strongly encouraged to send post cards from your various vacation spots to add to my collection!

Dave Dobos is very active in the Republican Central Committee in Columbus, Ohio. Dave's new venture is a direct marketing company which he formed late last year. Direct Micro will offer microcomputer accessory products to consumer end users. Dave expected to begin conducting business in January. David has also been bitten by the travel bug. He took a memorable 4,800-mile drive to the west last year visiting some of our nation's more beautiful parks and national monuments. This summer he'll be heading to Europe to visit relatives in Hungary. . . . **Steven Gaskin's** note makes me concerned about what they're adding to the drinking water in Sudbury, Mass. (Maybe **Chris Barnett** could check into it.) He writes, "I'm a successful executive now. I own a Bentley, two Mercedes-Benzes, and the obligatory BMW. I recently won the Nobel Prize for physics in my spare time." Luckily I do not feel responsible for verifying all of the information sent to your secretary.

It is with great sadness that I report the death of **Erland van Lidh de Jeude** on September 23, 1987, in New York City. He succumbed to a viral infection. Although Erland entered with the class

of '76, he took his bachelor's in computer science and engineering in 1977. Many of you will fondly remember his filling Lobby 10 with song during MTG productions seasons. Erland was certainly one of our nationally more visible alumni, having appeared in several motion pictures, including *The Wanderers*, *Stir Crazy*, and most recently *The Running Man*. He worked also as a computer consultant. Our sympathies are extended to his family, and most especially his wife Annette, and his young son Christian.

I'd like to finish with my own news this month. **Paul Hertz** and I are happy to announce that we are expecting our third child in early August. By the time you read this, Paul will have returned from a one-week visit to the Institute for Space and Astronautical Science in Tokyo in February, and I will have stopped feeling ravenously hungry every two hours! Please contribute—this is your column!—**Ninamarie Maragioglio**, Secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

78

10th Reunion

Only two months until reunion (June 3-5). Three days of fun and (hopefully) sun in Cambridge trying to remember what it felt like to be 19. Go boating on the Charles or diving for spoons in the moat, fun and games! Bring the spouse and the kids—but be there. Class of 1977? '79? '82? '35? Come on along! Any questions, write to me at the address below. And volunteers are always welcome.

This month's column is disproportionately dominated by doctors and children—not to mention doctors with children. . . . **Julie Keller Pease**, M.D., has begun a practice in psychiatry in Biddeford, Maine, near Portland. Biddeford is just her latest stop in a ten-year journey back to Boston, including Minneapolis (med school), Livingston N.J. (internship), and most recently Burlington, Vt. (residency). Next stop ought to be within Rt. 128. Julie writes that she will be at the reunion.

Now doctors with kids. **David Levens** write that he is chief resident in plastic surgery at Montefiore Hospital in the Bronx and will be finishing up in June (just about reunion time). David and wife Linda (director of Program Analysis for CBS Sports) are expecting their first child in April. . . . **Gordon Zuemdorfer**, a resident at Kingsbrook Jewish Medical Center in Brooklyn, writes about his two boys, Adam (age 3) and Eric (age 1). (By the way Gordon, there'll be babysitting and child care at reunion, so bring the kids.)

Now to babies without M.D.s. **Katherine A. Richardson** (Ph.D.) writes that she married Frank Richardson, '77, and that they have a 3-year-old girl. Katherine is working as a senior toxicologist at Eli Lilly in Indianapolis. (Puzzle: Is this Katherine nee Koren or nee Rozanski or another Katherine? Answer to be announced at reunion.)

Rob Milne writes from Four Winds, Logie Grae, Westfield near Bathgate, Scotland, where he lives with his wife Val, his children (Alex, 3, and Rosemary, 1), the horse Chips, the pony Billy, the Rottweiler puppy Logie, and three other beings (not described, but probably horses) named Spikey, Tummy, and Hansel. Rob, when not breaking horses, works as an entrepreneur in vibration and process monitoring and electronics and climbs mountains for recreation (last summer Mt. St. Helens and Mt. Rainer). Rob writes that he hopes to be at reunion. Now if he can make it from the U.K., can't you make it from the U.S.?

Carolyn Myers Conrad's baby Jacquelyn was born just last June 20 and "she has already developed a disposition which, at times matches her red hair!" Carolyn has "retired" from her engineering job at Bethlehem Steel's plant at Sparrows Point, Md. Husband Dave stayed on at Bethlehem Steel. Carolyn says, "We're both enjoying parenthood—it's my most satisfying job yet!" They will try to make it to the reunion. . . . **John Slater** and his wife Ellen had a baby boy (Joseph) last June, just two days after Carolyn's



The tribute flowed as freely as the champagne when John B. Miller, '74, christened a new shell for M.I.T.'s women rowers late last fall. Miller was honored as founding coach of women's rowing at M.I.T., and ever since then he has been "a constant factor in the development of women's crew," said Ingrid Gorman, '76. It became a family project when Miller married Joan Whitten, '80, described at the christening as "one of M.I.T.'s finest oarswomen," and it's clear that son John, Jr., is preparing to follow in the tradition.

baby was born. John teaches in the Civil Engineering Department at M.I.T. He has no excuse not to make it to the reunion.

Now to the Boston area. **Bob Asher** wrote to me back in November volunteering to help out at reunion. That is true spirit. Bob is now a partner specializing in patent and trademark law for the firm of Dike, Bronstein, Roberts, Cushman and Pfund in Boston. . . . **Douglas Denholm** and **Robert Maresca** both recently moved back to the Boston area. Doug is living in Belmont and working for Aspen Technology, an M.I.T. spin-off developing software to simulate chemical processes. Robert lives in Milford and works for Bose in Framingham. Previously Robert had worked for Philips Research Labs after getting his master's in electrical engineering from Stanford in 1980.

Kudos to **Charles Lindberg** for his promotion to associate at GZA, a geotech engineering and environmental consulting firm. . . . Same to **Elaine Harris** who got her M.B.A. from Stanford and is now working for DuPont in New York. . . . **Kelvin Okumura** writes that he is still at Hewlett Packard working in marketing. Kelvin got married last July to Lydia Liberek of Belgium.

Last and least, your intrepid secretary. Little has changed here. I'm still in the Planning Department at Boston's University Hospital; Yuko is still at Strategic Solutions (watch for the Strategic Solutions' Software Solutions Guide, coming your way soon), and we still live in a beautiful rent-controlled ghetto in Harvard Square.

There is one change in my life relevant to you. Effective June 5, 1988 (the last day of reunion), I

plan to retire as your secretary. No weepy good-byes until June. Right now, I'm looking for a few good volunteers. We already have one, who will remain unnamed. If there are any of you out there who enjoy gossiping, receiving boring postcards, and battling editors, step forward. The election will be on the last day of reunion.

Ah yes, reunion. . . . our tenth year college reunion. It will be fun, even without you; but it'll be even more fun with you—all of you. If you haven't yet made your plans or reservations, do so today. If you haven't yet volunteered, do so tomorrow. Call your old buddies, bring your family, pack up the old Chevy and come to Cambridge June 3-5. Questions, volunteers, complaints, or boring postcards, write or call me.—**David S. Browne**, Secretary, 50 Follen St., #104, Cambridge, MA 02138, (617) 491-5313. Be there!

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I regret to announce the death of **Thomas Trobaugh** on October 22, 1987. At the time of his death, Thomas was in a doctoral program in media technology at M.I.T., studying acoustics, artificial intelligence, and music, and was living in Somerville. Our sincerest sympathies go to his wife, Marcia Lewin, and their infant son, Jaron.

Gerald Michael is still in the army, and has been a captain since October 1983. He writes, "My last assignment, from March 1986 to May 1987, was as the commander of the 2nd Armored Division's Transportation Co. I had about 100 people and 60 trucks, ranging from pickup trucks to tank transporters. Since August, I've been attending the Naval Postgraduate School here in Monterey, Calif. I'm working on an M.S. in electrical engineering in the Space Systems Engineering Program. I'm due to graduate in March 1990. After that, who knows? I should find out in about two years."

Larry Rosenstein reports, "I am still working at Apple Computer, Inc., developing object-oriented systems in the Advanced Technology Group. I recently celebrated five years at Apple, which makes me somewhat of an old-timer. Finally, I have joined the ranks of homeowners, after buying a house in Santa Clara, Calif." . . . **Dixie (Kaufman) Paulos** and **John Paulos** had their first baby, James John, last August 4. They live in Raleigh, N.C. . . . **Joel Feldman** works for Kurzweil A.I. in Waltham, Mass., and lives in Cambridge.

David Millar reports that he and wife Robin had a son, Peter Robert, last November 6. David is still working at Campbell Soup and playing "lots of old-time fiddle and clawhammer banjo." The Millars make their home in Delanco, N.J. . . . **Pryor Garnett** has been living in Seattle since graduation and has been married since 1980. Pryor is a patent attorney in the firm of Graybeal, Jensen & Puntigam, specializing in computer software protection and licensing. Wife Kathryn is the office manager of the Seattle Biomedical Research Institute.

A press release from the Southwestern University School of Law in Los Angeles announces that **Bo Kyung Chi** has been accepted to their four-year evening law program, leading to the Juris Doctor degree, and has been awarded a John J. Schumacher Minority Leadership Scholarship. Bo has a Ph.D. from Caltech in chemical engineering and is a senior engineer for the Aerojet Ordnance Co. He and wife Katherine make their home in Montebello, Calif. . . . The *Middlesex News* (Framingham, Mass.) reports that **Steve Meretzky** works for Infocom in Cambridge, Mass., writing computer games—more specifically, interactive fiction. Steve actually got his degree not in computer science but in construction management. After graduation, he held a series of boring construction jobs before joining Infocom in 1982 as a game tester (nice work if you can get it).

One of the benefits of my new job in office automation technology and planning is that I now have a personal computer (actually an AT&T

6300) at home, courtesy of Mobil. Finding the space for one in a Manhattan apartment is no mean feat. But it means I can write (read "word process") my column at home instead of staying after work to do it. Ah, the joys of modern technology! Until next time—**Sharon Lowenheim**, Secretary, 303 E. 83 St., Apt. 24F, New York, NY 10028

81

Hello everybody. I hope that everyone has had a good winter. Judging from this past week in Boston, the cold weather feels like eternity. However, with class notes for the April issue due tomorrow, spring cannot be too far away. Brrrr!!

It is my sad responsibility to report the death of classmate **Daniel Theriault**. Daniel, his wife Candice, and their 2 1/2-year-old daughter Jennifer were found dead in their Leominster, Mass., condominium in early December 1987. Daniel is survived by his parents of Fort Kent, Maine.

In other news, **Laura Lee Davidson** recently graduated from the Sloan School of Management. . . . **Billy Watkins** is completing the final year of his emergency medicine residency at Martin Luther King General Hospital in Los Angeles. His wife Phyllis is attending law school which, according to Billy, qualifies the pair as SINKs (Single Income No Kids). . . . **Ellen Fischer** writes from Brooklyn, N.Y. to say that she continues to enjoy her work in fund raising and curriculum development. She has recently started free-lance textile design.

Joshua Littlefield and his wife Suzy had their second child, Robbie, born May 2, 1987. Josh is working for Access Technology in South Natick, Mass. Congratulations to Josh and Suzy and to Barb and **Jeff Green**, whose daughter Whitney was born September 20, 1986 (Jeff was a little delinquent in writing to his class secretary!). The Greens are currently living in Stanford, Calif., where Jeff is a first-year student at the business school. . . . **David Hills** completed his master's degree in systems management from the University of Southern California in August 1987. He's living in Washington, D.C., working on advanced engines at Air Force Systems Command Headquarters, Andrews Air Force Base, Maryland. David says that he is really enjoying D.C. and that **Bill Shelton** is working in the same office. . . . **David Pickney** is working as a systems analyst for Tandem Computers, specializing in telecommunications services and products.

Joe Kesselman is enjoying his engineering career at IBM in upstate New York. Joe says, "I am coming to the end of a two-year project. I can finally point at something and say I built that . . . which is why I became an engineer in the first place." Congratulations. . . . **Joe Garcia** has completed his first year at Hamilton Standard in Windsor Locks, Conn., after leaving active duty in the U.S. Navy. He recently purchased a house in Enfield, Conn., and encourages classmates to stop by. . . . **Richard Scheuermann** and his wife Nancy are part of the international set. Following graduation from the University of California at Berkeley with a Ph.D. in molecular biology, they moved to Basel, Switzerland, where Rich has been doing immunology research at the Basel Institute of Technology. They enjoy skiing, traveling, and meeting new people.

Finally, this column would not be complete without this month's installment of the missing classmates file, the perfect opportunity for classmates to request the reappearance of their less communicative friends. As a point of information, requests for missing classmates will not be printed unless the requestor supplies information about him/herself. We look forward to hearing from: **Steve Adams**, **Carl Awh**, **Anne Bagg**, **Thomas Barta**, **Gene Becker**, **Elliott Berger**, **Anne Casey**, **Daniel Cheng**, **Harry Choo**, **Harry Chou**, **Lei-Ching Chou**, **Gail Cooper**, **Matthew Dolan**, **Joel Eisen**, **Sue Fine**, **Mary Finn**, **Paul Gault**, **Janet Grzywacz**, **Williams Haskins**, **John Hou**, **Don**

Johnston, **Lisa Kauffman**, **Anne Keanan**, **Lisa Klein**, **Russell Kurtz**, **Janine Nell**, **Russ Price**, **Dinah Sah**, **Ken Schoedorf**, **Lee Silverman**, **Kris Speelman**, **JoAnn Stock**, **Rose Tse**, **Rose Wesson**, **Walter Zwirble**. Please keep the cards and letters coming. Have a great spring!—**Lynn Radlauer Lubell**, Secretary, 216 Beacon St., Boston, MA 02116

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Tim Anderson is still making flight simulators with the Singer Co. in Binghamton, N.Y. He writes that he is married but has no children: "must be doing something wrong—the manual never gives enough detail." Tim swims twice a day and has his eye on the masters nationals in Buffalo in August. Let us know how you do. . . . **Skip Butler** is living in Italy. . . . **David Borhani** moved down the river after receiving his Ph.D. in chemistry at M.I.T. in 1986; he's doing protein crystallography at the Harvard Department of Biochemistry. . . . **Dan Kessler** is in residency in anesthesiology and critical care medicine at Johns Hopkins Hospital in Baltimore. He reports that he is still singing, both barbershop and light opera.

For once, I can report a marriage in advance: **Bryan Fortson** will be getting married to Michele Byrdson in Atlanta in June. . . . **Yvette Martin** is doing a residency in obstetrics/gynecology at the Medical College of Virginia in Richmond. . . . **Daniel Metzger** is studying at Concordia Theological Seminary in Fort Wayne, Ind. When he finished in May 1990, he will be ordained into the ministry of the Lutheran Church—Missouri Synod. . . . **Joe Minahan** is a postdoc at the University of Florida, having recently finished his graduate work in physics at Princeton.

Continuing in alphabetical order, I spoke recently with **Jim Olivo**, who trades options for Chemical Bank in New York City, having graduated from the University of Chicago business school. Jim married Susan Ingrassia last summer. Among the many Pi Lams at the wedding was **Joe Simko**, who Jim reports works for Bell Labs "somewhere in Pennsylvania." . . . **Alex Storrs** got his Ph.D. in astronomy from the University of Hawaii and is doing an NRC postdoc at the Goddard Space Flight Center. He reports that **Heidi Hammel** and **Darren DePoy** are working on degrees at the University of Hawaii. . . . **Tanner Wray** recently started work toward a master's in library science at Syracuse University. After completing the degree, he plans to be a science librarian in an academic or corporate library.

Our West Coast correspondent checks in with news from some of our classmates who settled in California. . . . **Anne Moroney** now lives in Santa Clara and is a CMOS product engineer at National Semiconductor. Since graduation she has visited Japan; she is currently studying philosophy. . . . **Helen Fray Smith** married Bill Smith and lives in Saratoga. She is currently director of sales at Optical Media in Los Gatos, after working at IBM for five years. . . . **Elena Rozier** and **Suzanne Hirschman** are working for Lockheed in Sunnyvale. Suzanne works on spacecraft energy control systems and is in graduate school at Stanford in electrical engineering. In her free time, she plays troubadour music in a medieval band. Suzanne reports that **Melissa Lepper** married Pax Goodson in Boston and that **Joan Purdy** and **Doug Thayer** are parents and live in southern California.

Keep those cards and letters coming in to East Coast correspondent **Linda Schaffir**, 18 Prospect Ave., Apt. B-2, Norwalk, CT 06850; West Coast correspondent **Michelle Gabriel**, 656 S. Fair Oaks Ave., D-211, Sunnyvale, CA 44086; or me.—**Stephanie Pollack**, 33 Trowbridge St., Cambridge, MA 02138

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5th Reunion

Our reunion is just around the corner, June 2-5. The tentative agenda looks something like this:

Thursday is Boston Pops night; Friday is Technology Day with a dinner at the boat house; Saturday, a barbecue at the volleyball courts with dinner at Des Verde; and a brunch Sunday at Michaela's. For those of us with little ones to contend with, there will be a day-care center set up to watch the munchkins. If you haven't made your reservations, please do so within the next couple of weeks.

Our class is expected to raise approximately \$30,000 as our class gift; that is roughly \$30 per person. I am hoping we will get at least \$50-75 per person. Let's exceed the expectations! I hope to see everyone there.

Cynthia Bedell married Mark Schmelz, '78, last year. They honeymooned in Korea and, upon their return, were the recipients of an all-expense-paid relocation to Alabama, compliments of Uncle Sam and the U.S. Army. Cynthia and Mark completed the advanced course for chemical officer and were allowed to leave Alabama and take on a new post in Natick, Mass. While in Massachusetts, they attended the wedding of Jon Bernays, '79, and Dr. Wendy Heiger. Cindy says she is looking forward to the reunion and spending time with our class again. She says she hasn't changed at all except for the fact that she is married and now a captain.

Ellen Kranzer is also looking forward to the reunion, even though she has been in Cambridge since leaving M.I.T. She has been studying for an MTPW at Northeastern and, in her spare time, doing staff work for APO national. . . . Upon leaving M.I.T., **Richard Schooler** went to work for Intermetrics and stayed there for three years. Then he toyed with the idea of becoming a boxer after seeing a rerun of Ali Frazier in the 1970s. I guess Ali's technique of "floating like a butterfly and stinging like a bee" really attracted Richard. Richard became somewhat disillusioned with the idea with the recent publicity on Ali and the affects from boxing. Consequently, he has decided to work down the street from Intermetrics with BBN Advanced Computers, Inc. Richard is going to get into the ring working with compilers for "Butterfly" parallel processors.

Hilton "Craig" Russell continues to protect us on the eastern front in Germany. He has spent the last year there, and many of our classmates have stopped by to say hello. Craig is near Frankfurt for the next three years. So, if anyone is passing through, please look him up. . . . **Roger Spellman** has spent the majority of the last year with Spellman Information Systems doing what no man has done before—setting different computer vendors to talk to each other. I think he meant that he is getting vendors to communicate with IBM equipment, but I'm not sure. Roger says that he is really enjoying life since he was married in March 1987. He is living in Somerville, and I feel confident he will be attending the reunion this June.

What has **Arthur Remy Malan** been up to? He joined the Context Corp. in September 1987 and loves it. He says he especially enjoys "the Oregon lifestyle, the great outdoors, local produce, berries of all kinds, vegetables, pink salmon. The only thing that they really lack is a good football team, Philadelphia Cream Cheese, and a local location for the 5th Reunion."

William Lin is "happily married" to Nora Wednesday. They were married last June 20 and honeymooned in San Francisco. William is now in his fifth year of a Ph.D. program at Princeton. He says he should be done in time for the reunion.

Lee Marzke works for Kollsman Instrument Co. designing instruments for commercial aircraft. He recently became a certified flight instructor and has been teaching at Lawrence, Mass., airport in his spare time. He says if you want to learn from the best give him a call. Lee works harder to see that we fly better.

James Kirk has decided to leave his post at the *Enterprise* and take on a new position as project manager of a startup biomedical company in Cambridge. He is attending Boston University at

night to obtain an M.B.A. as part of the new Federation requirements. . . . **Mark Branch** recently graduated from North Carolina Medical School at Chapel Hill. He will continue on with his internship in internal medicine at Vanderbilt University. He said that he will be at the reunion. Now if Mark will be there with his hospital schedule, I know everyone else can be there as well.

The Celebrity '83 for this issue goes to **Eric Gold**. Most of us might think Eric would win the award because of his culinary talents, but such is not the case. In fact, Eric has been interested in expanding his artistic talents in the kitchen to the canvas, as well as other fine arts. After spending the last four years going from kitchen to kitchen, Eric and Scott Hanson have proposed the White Mountain Museum of Fine Art. Although the museum is still in its developmental stages, Eric has secured a number of M.I.T. officials to help take part in its creation. On November 12, 1987, at the Fox Ridge Resort, in North Conway, N.H., there was a formal presentation on the proposed White Mountain Museum of Fine Arts project. Eric has been trying to solicit support for his project for the last nine months, and now it looks like it will become a reality. Eric will be in attendance at the reunion to talk about his proposed museum. This entrepreneurial spirit in the fine arts has earned Eric the respect of his peers and recognition in the community but, most importantly, Celebrity '83 status.

As for myself, I am still in marketing with IBM. **Al Bashawaty**, '84, and myself have been having a great time in Port Washington, N.Y. Al recently celebrated his 25th birthday in classic style. First, Morgan Guarantee Trust promoted Al to assistant vice-president. He is now in charge of developing all leasing transactions on behalf of the bank. I suppose it is closely related to new product development. After being promoted to AVP, he flew out to California where he subsequently won two consecutive golf tournaments. The first tournament was at Spy Glass next to Pebble Beach, and the next one was at Diamond Oaks outside of Sacramento. It was a 25th birthday to remember.

I am looking forward to seeing everyone at the 5th reunion. I am sure it will be the best 5th reunion of all time. Until then, keep the letters coming.—**John E. De Rubeis**, 14 Charles Ave., Port Washington, NY 11050

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The credit for this month's column goes to **Mark DeCew**. Without his help, this would have been about six sentences' long. We need more people writing in with good gossip to keep this column interesting!

Steve Knapp writes that he is living in Silicon Valley with roommate Pat Foley '82, and is a field applications engineer with Xilinx, a semiconductor startup. Pat is working at Lockheed on the space telescope. . . . **John Inadomi** is finishing medical school in San Francisco. . . . **Pamela Melroy** is still flying KC-10 (Military DC-10) for the U.S. Air Force. She was selected for an upgrade to captain (left seat) in December. . . . **Peter Lemessurier** writes that he is presently the supervisor of mechanical engineering at the Jackson Laboratory in Bar Harbor, Maine. However, he is looking for work in the cogeneration field (because it is a fast growing, exciting field).

Mark-Tami Hotta has been busy since graduation. He is currently working on his M.B.A. at Stanford. Prior to this, he worked three years as a management consultant for Booz, Allen, and Hamilton in Tokyo and Chicago. He spent last summer working as an investment banker for the First Boston Corp. in New York. And if that's not enough for you, he is also a freelance automotive journalist on the weekends, test driving new sports cars. He has had an article and photographs published in *Motor Trend* and *Automobile*, and was quoted in *Fortune*.

As for my gang, people seem to be on the move. **Kathleen Harragan** has moved to Boston,

still working for IBM. . . . **Carolina Leonard** moved to Los Angeles and is now working for Aerospace Corp. . . . I tried to contact **Lillian Chiang** over the holidays and found out that she was in Taiwan. . . . **Mike Battat** has just returned from a six-month business trip to Windsor, England. He is working for Zentel, a division of Teradyne. . . . **Sue Marinow** tied the knot with Fletcher in February at the M.I.T. Chapel. She was out for a visit/business trip to Los Angeles last September, and we hit a few of the clubs.

And now for the news that Mark collected. **Jeff Meth** is in a Ph.D. program at Stanford in chemistry, as are **Melissa Hines** and **Virginia Wang**. . . . **Lauren DeRosa** is also working on a Ph.D. at Stanford. . . . **Chris Velasquez** is working on a Ph.D. in organic chemistry at Northwestern. . . . **Gary Oberbrunner** is working at Masscomp in Boston and is looking at grad schools for the fall. . . . **Eugene Halbrooks** is working at a software place in Cambridge.

Betty Beitz and **Tom Ranshoff** were married and, as far as we know, Betty is still at IBM in San Jose. . . . **Vicki Rodak** is living in Washington, D.C. . . . **Tonya Segal** and **Dave Weinstein**, '83, are both finishing up at Wharton Business School. . . . **Bruce Klein** opened up his own car wash in Huntington, Long Island. . . . **Albert Pleus** and **Pam Mitchell** were married last April in Hawaii and are both at Stanford Business School. . . . **Penn Edmonds** and **Athena Nikolaidou** are married and have bought a house in Cambridge. They are also expecting!

Mary Kay Biscan married an Australian doctor and moved to Australia. . . . **Geoff Campbell** is living in Goleta, Calif. . . . **Ken Huggins** is running his own construction company in Columbia, S.C. . . . **Gregor Koso** is a computer programming revolutionary in Cambridge. . . . **Mark Piat**

M.I.T. ALUMNI CAREER SERVICES

Gazette

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is escaping from the air force. . . . **Peter Quigly** has his own company making high-tech wind surfer booms. . . . **Henry Minsky** and **Milan Fingh** are getting married in April.

Lars Rosenblad and **Eileen Edwards** are getting married in September. They just bought a house in Long Beach. Lars is working for Douglas Aircraft, and Eileen is working for her family paint company. . . . **Mike Sorter** was in Los Angeles for New Year's. He lives in Somerville but has been traveling to Japan and Korea for the auto company he works for. . . . **Sarah Tabler** is living in Jonesboro, Ga., and Mark and I would like to hear from her to see what she is up to.

That's all the news we could muster for this month. A couple of us are toying with the idea of planning a class of '84 event most likely in Los Angeles for this summer. If anyone would be interested, please drop me a line so we can see if there is any interest.—**Diane M. Peterson**, President, 350 Palos Verdes Blvd., Apt. 20, Redondo Beach, CA 90277-6329

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Our illustrious class president is still in West Germany. She has been promoted to first lieutenant and is currently serving as a flight commander with the 6912th Electronic Security Group. She wrote that she is engaged to be married to "Wayne." He looked very familiar—who is this Wayne, Inge? . . . **Mark Staples** has also been promoted to first lieutenant. He is a systems readiness engineer with the Electronics Systems Division at Hanscom AFB. He is married to Barbara Fuertges. . . . **Gary Wilson** has been designated a naval aviator.

There is hopeful news regarding **Ramanujam Manikkalingam**. He has been imprisoned in his home country of Sri Lanka for over a year and may be released under the peace accord in that country. President Gray spoke to the Sri Lankan prime minister to make sure Manikkalingam gets "due process."

David Torrey joined the Department of Electrical Engineering and Computer Science at M.I.T. in January as an assistant professor. His research interests include rotating machinery, electromechanics, power electronics, and control of energy systems. . . . **Atul Jain** and **Mike How**, '84, founded a software services firm in 1986. Their clients are primarily research departments of some prominent investment banks. They hope to bring some commercial software products to market in early 1988. They are both living in New York City. . . . **Catherine Chen** is taking a year off from Harvard Medical School to attend the Howard Hughes Medical Institute/NIH Research Scholars Program. She is having a wonderful time taking in the sights of Washington, D.C., and working in an immunology/cell biology laboratory at NIH on the T-cell receptor. . . . **Hisaya Sugiyama** is working towards a master of architecture degree at Harvard's Design School. He claims that having a M.I.T. background is definitely a big plus in a school where being analytical is something people talk about as if it were a distant dream. . . . **Carol Yao** and **Duhee Lee** are also at Harvard.

Arthur Mellor has moved back to Boston from San Diego. He is living in Watertown and working for BBN Advanced Computers. . . . After working for a landscape architecture firm for two years, **Meg Gower** has gone on to work on her master of landscape architecture degree at University of Michigan. She is still enjoying sailing but now in the waters of the Great Lakes, and says U.M. has nothing on M.I.T. sailing! U.M. has a small pond a half hour from campus. . . . **Ardres Grandea III** wrote that he could be anywhere in the continental U.S. attending graduate school for molecular biology this fall. . . . Well, **Winston Smith** isn't in the continental U.S. He and his wife, Jane Langley (Wellesley '85), are in West Germany. He is working for Perkin-Elmer Corp. in the Optical Group.

Oren Michels is living in Westside, Calif., and is back in school. He is getting an M.B.A. in entertainment management at UCLA's Anderson School. He enjoys not working and being able to come home and go for a swim after class—"they should put in a pool at Baker house." . . . **Rodney Schmidt** is still at Hughes in Fullerton. . . . **John Hradnansky** left Hughes after grad school and is now working in San Diego with some other SAEs. . . . **Andy Westcoat** moved to Los Angeles last September and is working for a refinery in Torrance.

Terry Cooper is still in Boston working for the Gilbane Building Co., which has her sprinting back and forth between Boston and Providence. She worked as a project engineer on two jobs, Rhode Island School of Design and Rosie's Place (a shelter for homeless women in Boston). Last summer she took a leave of absence from Gilbane to run her own renovations project at Charles St. AME Church in Roxbury, Mass., doing business as Cooper Interiors. Last May she became engaged to Derrick Smith. They will be married on October 8 in New York City.—**Stephanie Winner**, Secretary, 1026 Live Oak Dr., Santa Clara, CA 95051

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Happy April Fools! It seems the holidays kept everyone busy because I didn't receive too many letters. So once again, I'll have to ad-lib.

Stephen Hushek is a design engineer for GE Medical Systems, RF and Analog Design Section, while attending Marquette University graduate school part time. He is studying for an advanced degree in electrical and biomedical engineering. . . . **Beatriz Garcia** had a barbecue in September attended by **Karla Johnson**, **Christine LeBeau**, **Alan Yueh**, and **Dave Russ**. Karla was on her way back to Ohio after some training in San Francisco on turbine engines; Christine was visiting Disneyland and works in San Francisco at an architectural firm; Alan is at USC grad school, and Dave works for Hughes Aircraft. Beatriz is with Hughes also, in the Radar Systems Group.

I need to correct a misprint: **John Briggs** is not working at Wang Labs but is still at M.I.T. studying for a M.S. in mechanical engineering. He will have finished up in January. . . . **Jaime Guillen** is working in the Division of Operating Events Assessment at U.S. Nuclear Regulatory Commission. He evaluates daily events at U.S. nuclear power reactors. . . . **Jeff Arenberg** has joined TRW's Control Systems Lab. . . . **Dan Kelp** is a grad student at University of Pennsylvania studying materials science and engineering. He is also a Unisys Ph.D. scholar. . . . **Linda Robeck** recently was hired by the Jet Propulsion Lab in Pasadena, Calif. She is working on the attitude control system for the Galileo spacecraft. . . . **Craig Poole** is a systems engineer at GTE in Taunton, Mass. He also finds time to serve as the assistant basketball coach for the M.I.T. men's team and as an educational counselor in the Somerville/Medford area.

Paul Laferriere is having incredible fun at Kirtland AFB in New Mexico. He shares a house with Jeanne Swecker, '83, and takes classes at UNM with Jack McCrae, '85. Over Columbus Day weekend, Eric Weaver, '83, got married, and a lot of Theta Chi's helped celebrate: **Mike Brothers**, **Brian Haney**, **Mike Cronin**, and **David Stampleman**. . . . **Brian Latt** is working at Reel EFX, a special effects company in Hollywood. Brian has acted in a number of off-off-Broadway showcases and regional theatre productions.

I received a Christmas card from **Fred Johnson**, who is gearing up for the ski season. He is competing on a team sponsored by a textile manufacturer. To help fund this, he's working as an engineer for a company that makes Lycra and Goretex-like fabric. . . . **Megan Smith** sent me a postcard from Australia. A group of M.I.T. students built a solar-powered car and were racing it from Darwin to Adelaide. At that time of her

writing, she was in ninth place (out of 25). . . . **Robert Lenoil** took a three-week trip through Thailand, Malaysia, and Indonesia. He is working for Apple in Mountain View, Calif. . . . **Mike Konopik** moved to Austin, Tex., to work for IBM. . . . **Ray Covert** moved from Texas to Boston to work for Northrop.

Finally, **Katly Kelly** dropped me a line from Lynnfield, Mass. She's in her second year at BU School of Medicine with **John Sapirstein**. Look out, they'll be hitting the wards in July. . . . **Payton James** is in the Los Angeles area working in a biomed lab. . . . **Lisa Spurlock** and **Pete Garfield** are in Boston's South End. . . . **Chris Raanes** is working at AOA in Cambridge and is about to move into a Marlborough St. apartment. He'll probably recruit Fred Huettig, **Tom Kurfess** and **Adriana Pradduade** to help. Tom and Adriana will be getting married soon. . . . **Scott Miller** expects to get his master's in mechanical engineering in June. . . . **Peter Tatian** is working at a non-profit hunger research agency in Washington, D.C.

Greg Harrison had a New Year's Eve party that was a lot of fun. He's been taking classes at USC with **Grace Tan**. Grace is working at the Jet Propulsion Lab.

That's it for this month.—**Mary E. Cox**, Secretary, SD/CLTP, P.O. Box 92960, Los Angeles AFB, CA 90009-2960

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I can't believe I'm already on my third column. By the time you read this, you will have graduated almost a full year ago. Do you feel older? Have you learned more at M.I.T. or in the real world? Drop me a line and tell me all about it. Your classmates want to hear from you.

To celebrate the New Year, I went to New York. **Ken Corless** (Arthur Anderson, New York City) had a party, and I saw **Dave Napoli** (Downstate Medical School, Brooklyn, N.Y.), **Janet Zahradnik** (M.I.T., graduate school, mechanical engineering), **Matt Kaplan** (Cambridge Training Institute), and **Dan Kennedy** (Oracle, Calif.). Cary Ching, '86, Lisa Swartz, '89, and Christine Leviness, '89, were also there.

Next night to New York City. **Maria Kozloski** (Morgan Guaranteed) took us out on the town. She's living with **Rick Smith** and **Chuck Jones**.

Back on the home front. **Kevin Chang** (economics grad., '88) and **Bob Frank** were hanging out in Baker House the other night. Bob was on vacation from graduate school at the University of Pennsylvania. He said, "It's definitely easier than M.I.T." Imagine that. Bob reminded me about a few U.A. people. **Ben Linder** is out in California working with **Dan Kennedy** and **Brian Hirano** at Oracle. . . . **Walter Rho** is still at Columbia Medical School, and **Brian Mosher** is working full force on Gary Hart's campaign for president. I was surprised to see him campaigning in Lobby 10 a few weeks before Hart rejoined the race. He must have had inside information.

Earlier this month, I saw **Arnie Burke**, '85, and **Ken Munson** in from California and **Denise Neirincx** in from Virginia for the Christmas holidays. Ken and Denise were visiting **Gene Cohen**, who has already changed jobs and is now working for a startup firm on Route 128.

I got a few news bulletins from members of our class. **Wendy Cone** is teaching mathematics at St. Bernard's High School in Connecticut, and **Simpson Garfinkel** is attending Columbia School of Journalism and consulting in Boston once a week.

Finally, I received a news release from the navy. **Michael Nowak** was one of 50 recent college graduates to receive the Office of Naval Research Graduate Fellowship. Congratulations, Michael.

Well, that's all the news I've got to print for now. Don't forget to write or call and fill me in with new details. Enjoy your summer.—**Stephanie Levin**, 3201 Eighth St., Charlestown, MA 02129, (617) 242-1618



COURSE NEWS

I CIVIL ENGINEERING

From Palos Heights, Ill., **Raymund V. McGrath**, S.M.'36, writes, "I am terminating 10 years as a consultant to the American Petroleum Institute's Division of Refining, which followed 40 years with CBI Industries. I still continue as chairman of the Planning Commission of Palos Heights."

James M. Symons, Sc.D.'57, writes, "I am currently chairman of the Department of Civil Engineering at the University of Houston. After leaving the M.I.T. faculty in 1962, I worked for the U.S. Public Health Service and the U.S. Environmental Protection Agency until 1982 when I went to the University of Houston. My research interests continue to be in the area of removing organic contaminants from drinking water."

Alberto B. Calvo, S.M.'72, of Newton, Mass., is currently manager of logistics engineering at TASC; he obtained the title of Certified Professional Logistician (CPL) from SOLE (Society of Logistics Engineers) in 1984. . . . **M. David Egan**, S.M.'66, reports from Anderson, S.C., that he is the author of *Architectural Acoustics*, published by McGraw-Hill, New York (January 15, 1988). . . . **Roland Luxenberg**, S.M.'84, works for Aquatec, Inc., South Burlington, Vt., where he is involved in a variety of water resources investigation including field data collection programs, laboratory experiments, and analytical studies. Aquatec is an environmental consulting firm offering chemical, biological, and engineering services.

Thomas W. Brockenbrough, S.M.'46, reports that he continues to be active as professor of civil engineering at the University of Delaware, Newark. . . . **G. Kelvin White**, S.M.'69, has been named president and chief operating officer and director of the Beta Optical Co., North Attleboro, Mass. Formerly, White served as president of Reed & Barton Silversmiths, Taunton. . . . **Theodore von Rosenvinge**, S.M.'80, has been promoted to associate of Goldberg-Zoino & Associates, Inc.; he is manager of the firm's Vernon, Conn., office. Von Rosenvinge has been with this geotechnical engineering/environmental consulting firm since 1979.

Edward C. West, S.M.'56, writes from Tamarac, Fla., of his professional activities since he retired in 1972 from the United States Army as colonel: (1972-76) served as president of Green International; (1976-79) served as president of Edward C. West Associates; and (1979-present) is president of Agripost, Inc., Pompano Beach, Fla. . . . **Keneth M.S. Mark**, Ph.D.'74, is chief civil/structural architectural engineer for Bechtel National, Inc. Mark lives in Albany, Calif. . . . **Jack Kinstlinger**, S.M.'54, is currently president of Kidde Consultants, Baltimore, Md.

The final phase of a satellite-linked flood alarm system for the Passaic River basin is being completed this spring by International Hydrological Services, Sacramento, Calif., of which **David C. Curtis**, Ph.D.'82, is founder and president. Automatic rain gauges in four New Jersey counties will collect and transmit rainfall information to

computerized base stations where flood analyses will be completed and, if necessary, warnings issued. Curtis was a flash flood hydrologist with the Northeast River Forecast Center, Bloomfield, Conn., six years ago when he realized that there was a market for "more than just a flood alarm system." So he founded IHS and developed a new generation of software, called Enhanced Automated Local Evaluation in Real Time (ALERT), for water management and quality control.

Two deaths have been reported to the Alumni Association with no further details available: Major General **Jackson Graham**, '40, of Palm Springs, Calif., in 1987; and **Gustav Juan J. Rizo Patron Remy**, S.M.'42, of Lima, Peru, on April 23, 1981.

II MECHANICAL ENGINEERING

Eric G. Newberg, Jr., S.M.'46, a retired commander in the U.S. Navy, has been elected vice commander-in-chief of the Military Order of the World Wars and was presented the order's Chicago Award for being the organization's top recruiter of the year. Newberg is employed as a project engineer in New Bedford, Mass. . . . **Michael G. Hollars**, S.M.'80, writes, "Completed Ph.D. in aeronautics and astronautics at Stanford University (December 1987). I will be working on space robotics and commercial satellites control at Ford Aerospace, Palo Alto." . . . **Burhan Ozmaz**, Ph.D.'84, of Dallas is involved in research and development on packaging technologies of new-generation air-borne computers for space and military defense applications.

William C. Menzies, Jr., S.M.'55, writes from Charlotte, N.C., "I have taken up snow skiing again after many years of dormancy. One slope lets me ski free because of my 'advanced age.' It is very gratifying to glide down the intermediate slopes and know that it will take the grandchildren a little while to catch up. Once you learn to get off the chair lift you are on your own! Life is like that—you have to get off your duff to enjoy it." . . . **John J. Wlassich**, S.M.'86, reports, "Moved to Washington, D.C., over the summer, still with the BOM Corp. Having a great time in this area."

Leonard Solomon, S.M.'69, has been at Harvard University for 16 years. In his current position of research program manager in the Division of Applied Sciences, he manages a research program on ozone depletion in the stratosphere. He is also chairman of a university-wide committee of computer system managers. . . . **John A. Clark**, Sc.D.'53, writes from Ann Arbor, Mich., "After 32 years on the University of Michigan faculty (mechanical engineering) and almost 10 years at M.I.T., I am now on retirement furlough during 1987-88. I shall retire from the active faculty in July 1988 and expect to continue my lifelong consulting in the general field of energy, including solar and nuclear."

A junior professorship named in honor of

George N. Hatsopoulos, Sc.D.'56, has been established in the department at M.I.T. by Hatsopoulos' firm, Thermo Electron Corp., Waltham, Mass. The firm is engaged in a variety of manufacturing and marketing activities, environmental and analytical instruments, systems for cogeneration and other industrial processes, biomedical materials, and biomedical and aerospace components. Hatsopoulos taught at M.I.T. for six years before giving his full-time attention to the start-up of his company; he holds four M.I.T. degrees—S.B. (1949), S.M. (1950), M.E. (1954), and Sc.D.

David C. Prince, Jr., Sc.D.'51, who earned international recognition for his design work on jet engines at General Electric, passed away in Cincinnati, Ohio, on October 16, 1987. Prince, a pioneer in applying fluid dynamic theory to the design of aircraft compressors and turbines, developed a "compressible flux plot" code for the design of blading, the first of its kind. Until his retirement last summer, Prince served as a consulting engineer, specializing in transonic flow in the fan component of aircraft engines, and his findings were widely publicized. Prince's leisure activities included sailing, skiing and figure skating.

Frank C. Gallagher, '31, who retired twice from the Massachusetts Bay Transit Authority, passed away on December 25, 1987. Following retirement in 1967 from the post of supervisor of engineering and maintenance, Gallagher returned to supervise the construction of new cars for the Red Line extension to Quincy until 1970. . . . **William H. Catha**, S.M.'65, a retired commander in the U.S. Navy, passed away in Jacksonville, Fla., on February 16, 1987. Catha served during World War II and recently was an instructor at St. Johns Community College, Jacksonville.

III MATERIALS SCIENCE AND ENGINEERING

The late **Parke A. Hodges**, S.M.'27, was the subject of a brief appreciation by James K. Richardson in *Mining Engineering* for September 1987. Hodges died in Cambridge, Md., on February 16, 1987, at the age of 85. He began his professional career after training in mining engineering at M.I.T. with a three-year contract as a shift boss in Braden, Chile, then worked in mining operations in Mexico until 1938. After 12 years with Climax Molybdenum, during which he was back overseas as a consulting engineer and geologist in Southern Rhodesia, Hodges joined Behre, Dolbear Co., New York, where he rose to be vice-president, president, and director before retiring in 1972. The breadth of Hodges' interests is indicated by his memberships: the Canadian Institute of Mining and Metallurgy, the Society of Economic Geologists, the Mining Club, the Explorer's Club, and the Cambridge (Md.) Yacht Club. He was "a model of integrity, honor, courage, perseverance, and humanity," said Hodges' friend Richardson.

A "Scrupulous" Evaluation Gives Tenure to 25 Faculty

With tenure you may stay; without it you must leave.

In this sense, the decision to grant or withhold tenure is the single most decisive step in selecting those faculty who will be M.I.T.'s future leaders.

Because the evaluation process is a "scrupulous" one, in the words of provost John M. Deutch, '61, "many people who are highly qualified teachers and

researchers do not receive tenure." Key requirements, as listed by Deutch, are:

- ☐ Substantial educational contributions.
- ☐ Substantial research accomplishments, including significant work in a single discipline or area.
- ☐ Reasonable "citizenship" at the Institute, defined as important involvement in department and faculty affairs.

The decisions are always difficult and frequently controversial, and the process often stimulates curiosity and concern in the M.I.T. community. Hence the decision of late last fall to release, for the first time in M.I.T.'s history, the full list of faculty granted permanent tenure.

The following 25 were named, effective last July 1:



☐ **Triantaphyllos R. Akylas**, Ph.D.'81, associate professor in mechanical engineering. For two years the Doherty Professor in Ocean Utilization, Akylas has specialized in wave generation and propagation and in the instability that is inherent in fluid flows. He holds a bachelor's degree from Caltech (B.S.'78).



☐ **Lallit Anand**, associate professor in mechanical engineering. Anand came to M.I.T. in 1982 to specialize in the mechanics of materials, especially strain deformation. After studies at the Indian Institute of Technology (B.Tech.'70) and Brown University (Sc.M.'72 and Ph.D.'75), Anand worked for six years as research scientist and senior research scientist at U.S. Steel.



☐ **Wai K. Cheng**, Ph.D.'79, associate professor in mechanical engineering. A specialist in engines and combustion, Cheng has made significant contributions to understanding the complex flow processes in spark-ignition and diesel engines and aircraft gas turbines. He studied at Caltech (B.S.'74) before joining the M.I.T. faculty in 1980.



☐ **Edward F. Crawley**, '76, associate professor in aeronautics and astronautics. Crawley is an authority in vibration and damping and the dynamics and control of structures in zero gravity; he originated a graduate course in structural dynamics and control. His advanced degrees are in aeronautics and astronautics from M.I.T.—S.M. in 1978, Sc.D. in 1980.



☐ **John M. Essigmann**, Ph.D.'76, associate professor in applied biological sciences. The founder of a new course in the methods and logic of experimental biology, Essigmann works chiefly on the critical issues of structural and functional damage to DNA by chemicals and radiation. He studied biology and chemistry at Northeastern (B.S.'70) before coming to M.I.T. for graduate work in toxicology.



☐ **Sy D. Friedman**, Ph.D.'76, associate professor in mathematics. A specialist in logic, especially in recursion theory and set theory, Friedman has also been in charge of M.I.T.'s mathematics colloquium and has served as the department's representative to the Educational Study Group. Friedman joined the faculty in 1979 following postdoctoral research and teaching at the Universities of Chicago and California (Berkeley).



☐ **Leon R. Glicksman**, '59, professor in architecture. A member of the Energy Laboratory since 1973, Glicksman has been for five years director of the Joint Program for Energy Efficient Buildings and is now leading an interdisciplinary program in building technology. His advanced degrees, in mechanical engineering, are from Stanford (M.S.'60) and M.I.T. (Ph.D.'64).



☐ **Philip M. Gschwend**, associate professor in civil engineering. As a member of the department's Water Resources and Environmental Engineering Group, Gschwend has made important studies of the processes that control the fate of chemicals in groundwater, surface water, and near-shore ocean water. He studied at Caltech (B.S.'73) and the Woods Hole Oceanographic Institution (Ph.D.'79) and before joining the faculty held postdoctoral positions in chemical engineering at M.I.T. and Indiana University.



☐ **Leonard P. Guarente**, '74, associate professor in biology. Guarente is recognized for research in the regulation of gene expression and for contributions to the design of a new M.I.T. teaching program in biotechnology. His graduate study in molecular genetics was at Harvard (Ph.D.'78), where he continued postdoctoral work in biochemistry and molecular biology until returning to M.I.T. in 1981.



☐ **Timothy G. Gutowski**, Ph.D.'81, Alcoa Associate Professor in mechanical engineering. Gutowski has served as director of the M.I.T.-Industry/Polymer Processing Program in the Laboratory for Manufacturing and Productivity, where he developed a major research activity in the use of polymeric composite materials. He holds degrees from the Universities of Wisconsin (B.S.'67) and Illinois (M.S.'68).

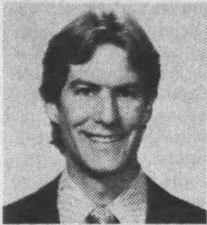


☐ **T. Alan Hatton**, associate professor in chemical engineering. A native of South Africa, Hatton came to the University of Wisconsin for graduate work (Ph.D.'81) after studies at the University of Natal and three years' service as a senior research officer for the South Africa Council for Scientific and Industrial Research. At M.I.T. since 1982, he has made important contributions in biotechnology processing.



□ **Monty Kreiger**, associate professor in biology. Recognized for work on cholesterol metabolism and the role of lipoproteins, Kreiger became the first Latham Family Career Development Professor at M.I.T. in 1985. He studied chemistry at Tulane (B.S.'71) and Caltech

(Ph.D.'76) and then had postdoctoral appointments at Caltech and the University of Texas Health Science Center before coming to the Institute in 1981.



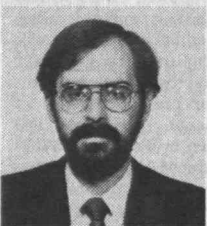
□ **Jeffrey H. Lang**, '75, associate professor in electrical engineering and computer science. A specialist in the control of sophisticated electromechanical systems, Lang was honored in 1986 with the Edgerton Faculty Achievement Award. Lang worked in industry while studying

for advanced degrees from M.I.T. (S.M.'77, Ph.D.'80), and he joined the faculty upon completing his doctorate.

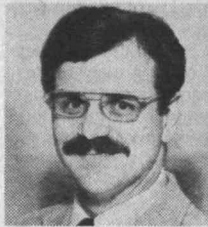


□ **Richard K. Lester**, Ph.D.'79, associate professor in nuclear engineering. Since joining the faculty in 1979, Lester has specialized in the issues that most affect the future of nuclear power—reactor research and development, utility management of nuclear generation, and waste

disposal. Currently he is executive director of the M.I.T. Commission on Industrial Productivity. A native of England, Lester studied chemical engineering at Imperial College (B.S.'74) before coming to the U.S.



□ **Tomas Lozano-Perez**, '73, associate professor in electrical engineering and computer science. An M.I.T.-educated specialist in artificial intelligence, Lozano-Perez worked in the AI Laboratory and at IBM before embarking on his master's degree (1977), and after completing his doctorate (Ph.D.'80) he was a research scientist for one year before joining the faculty. He has done influential work in robotics science.



□ **Terry P. Orlando**, associate professor in electrical engineering and computer science. An expert in quantum transport phenomena and superconductors, Orlando is now involved in studies of new ceramic- and silicon-based materials. He has been at M.I.T. since 1981 after completing

academic work at Louisiana State University (B.S.'74) and Stanford (M.S.'76, Ph.D.'81).



□ **Paul Osterman**, Ph.D.'76, associate professor in management. Though he has been associated with Sloan School research since receiving his doctorate in urban studies and planning, Osterman joined the M.I.T. faculty only last fall to work in labor economics, employment

policy, and human resource development. His undergraduate work was at Oberlin (B.A.'68), and from 1976 through June 1987 Osterman was a member of the Boston University faculty.



□ **Ruth Perry**, professor in the School of Humanities and Social Science. Perry is the founding director of the M.I.T. Women's Studies Program, having come to the Institute to teach literature and women's studies in 1982. Her degrees are in psychology (Cornell, B.A.'63,

M.A.'65) and literature (University of California at Santa Cruz, M.A.'70, Ph.D.'74).



□ **Harriet N. Ritvo**, associate professor in humanities. Ritvo came to M.I.T. in 1979 as a lecturer in writing after three years on the staff of the American Academy of Arts and Sciences. She has since then been working with students in the Writing Center while achieving a

reputation as a versatile and original scholar of the Victorian age. Ritvo studied at Harvard (B.A.'68, Ph.D.'75) and Girton College, Cambridge, England.



□ **Paola M. Rizzoli**, associate professor in earth, atmospheric, and planetary sciences. A native of Italy, Rizzoli came to the U.S. for graduate study at Scripps Institute of Oceanography (Ph.D.'78); she joined M.I.T. in 1981 to work on a broad range of topics in oceanography and meteorology, and her colleagues now say she is one of the world's leading oceanographers.



□ **Candace L. Royer**, associate professor in athletics. Royer came to M.I.T. as head coach of women's tennis in 1981; she also serves as assistant director of physical education and manager of tennis facilities. She was honored in 1982, when women's tennis at M.I.T. compiled a 14-2

record, as Division III Coach of the Year by the Intercollegiate Tennis Coaches Association, on whose board of directors she now serves. Royer holds degrees in health and physical education from Penn State.



□ **Richard J. Samuels**, Ph.D.'80, associate professor in economics. As founding director of the M.I.T.-Japan Science and Technology Program, Samuels is recognized as an expert on Japan-U.S. technology transfer and Japanese business and government programs in technology and policy. He has been at M.I.T. since

taking degrees from Colgate (B.A.'73) and Tufts (M.A.'74), and he is also associated with Harvard's Reischauer Institute.

□ **Robert Stalnaker**, professor in linguistics and philosophy. Stalnaker will come to M.I.T. next July 1 from Cornell, where he is professor of philosophy. In his recent book, *Inquiry*, Stalnaker brings together his research in the philosophy of mind and of language. His doctorate in philosophy is from Princeton (1965).



□ **Anne M. Wagner**, associate professor of architecture. A specialist in art history, Wagner studied at Smith, Yale (B.A.'71), Brown (M.A.'74), and Harvard (Ph.D.'80) and taught at Wheaton, the University of Massachusetts/Boston, and Vassar before coming to M.I.T. in 1983.

She will leave the Institute in June to take a tenured position at the University of California in Berkeley.



□ **Kenneth N. Wexler**, professor in the Whitaker College of Health Sciences, Technology and Management. Wexler will come to M.I.T. next summer from the University of California at Irvine, where he has become a recognized leader in the field of psycholinguistics and cognitive science. He studied mathematics at the University of Pennsylvania (B.A.'64) and psychology at Stanford (Ph.D.'70). □

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IV ARCHITECTURE

Jon J. Scott, M.Arch.'67, of Hoskins Scott Taylor and Partners, Inc., was partner in charge of a new Atrium Pavilion project for University Hospital, Boston, completed late last year. The new structure provides the hospital's core clinical facility and main entrance—"a new image for the hospital," according to HSTP's announcement of the project. It contains 233 beds and new acute medical/surgical intensive-care facilities. Other HSTP projects now in progress in Boston include new inpatient facilities for Boston City Hospital, Parkside East condominiums overlooking Boston Common, and 110 Arch Street, a 20-story office and retail building.

Alfonso Goveia, M.A.A.'77, of Mexico City has won M.I.T.'s first Lawrence B. Anderson Award for his proposal to document the history of housing types in Mexico City through the 1990s. There will be special emphasis in Goveia's work on the housing built for emergency use after the 1985 earthquake; he wants, he says, "to transform this reconstruction experience into knowledge for future interventions." The prize honors the former head of the department and dean at M.I.T. who is now retired to Lincoln, Mass. Goveia is partner in the firm of Diseno, Planeacion y Sistemas.

Alex Loy Seid, M.A.A.'74, is working as senior aviation planner/programmer in the Department of Planning at the Massachusetts Port Authority on site development plan/design guidelines for Hanscom Field and Logan Airport facilities in response to proposed third harbor tunnel project for Boston. . . . John Sullivan, Jr., M.Arch.'38,

writes from Dayton, Ohio, "Spent 1987 traveling and painting (water colors) and pencil sketching." His travels: "January-May, Australia with a stop in Napa, Calif. and Hawaii; June-July, Canada and Alaska; August, Dayton organizing a one-man painting show (sold several); September-October, New York City, Yugoslavia with M.I.T.-Bradford tour; and then three weeks in Italy, painting and sketching."

Marc Maxwell, M.Arch.'85, is currently working as a project manager for Building Diagnostics, Inc., a design research and consulting firm specializing in retirement housing. Maxwell lives in Somerville, Mass.

William V. Reed, M.Arch.'33, an architect and pioneer urban planner in Puerto Rico for 20 years, passed away on April 16, 1987 in Sarasota, Fla. Reed worked in community projects throughout his career. During the New Deal years, Reed served as principal project planner for the U.S. Housing Authority. In Puerto Rico beginning in 1950, Reed played a lead role in forging the New San Juan concept in Hato Ray, with his major intent to build homes within walking distance of office buildings and industrial plants to minimize vehicular traffic. He served as vice-president of IBEC Housing Corp. and also taught social science at the University of Puerto Rico. . . . Radoslaw Zuk, M.Arch.'60, was elected a fellow of the Royal Architectural Institute of Canada.

V CHEMISTRY

James T. Snow, Ph.D.'87, writes, "My wife, Melody, and I are living in Austin, Tex., where I am a principal investigator for Texas Research Institute in the Applied Research Department and Melody is a pension plan administrator for Plan Data. We are enjoying the warmer climate and enjoying sailing whenever possible on nearby Lake Travis. We invite classmates to give us a call if they are ever in this area." . . . Charles James Bier, Ph.D.'71, has been promoted to professor of chemistry at Ferrum College, Va., and took a sabbatical in Spring 1987 to pursue studies in peace, justice, and conflict resolution. . . . Philip Gary Mennitt, Ph.D.'62, has been elected chairman of the Department of Chemistry, Brooklyn College,

1987-90. . . . Robert Damrauer, Ph.D.'68, is spending the year on leave from the Chemistry Department at the University of Colorado, Denver, as a program officer in organic dynamics at the National Science Foundation.

A \$500 prize for outstanding graduate work has come from Phi Kappa Phi, the national scholastic society, to Denise A. Schneeberger, a graduate student in the department at M.I.T.

K. Barry Sharpless of M.I.T., whose work in oxidation methods has revolutionized the field of organic synthesis, has been honored with the Arthur C. Cope Professorship. Sharpless has been at M.I.T. since 1970 except for three years as a member of the Stanford faculty from 1977 to 1980.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Can artificial intelligence be used for manufacturing? The question was the subject of a talk by Gerald Barber, Ph.D.'82, founder and vice-president for research and development of Gold Hill Computers, Cambridge, before the Boston Section of IEEE late last fall. Promoting the meeting, IEEE's *Reflector* called Gold Hill "a key artificial intelligence company focusing on an easy-to-use program for a knowledge-based system . . . on a personal computer."

For its annual briefing for the media on new developments in electrical engineering and computer science in New York late last fall, IEEE turned—among others—to three members of the M.I.T. community: W. Daniel Hillis, S.M.'81, founding scientist of Thinking Machines Corp., Cambridge, on parallel processing; James L. Flanagan, Sc.D.'55, of AT&T Bell Laboratories on "talking" with machines; and Praveen Chaudhari, Sc.D.'66 (III), vice-president for science at IBM's T.J. Watson Center, on superconducting devices and circuits.

John C. Poulos, S.M.'77, writes, "I am presently a senior associate at Booz, Allen & Hamilton, Bethesda, Md. I conduct technology and management consulting projects in the area of telecommunications." . . . Teddy Huang, E.E.'68, has been promoted to head, Switch Peripheral Maintenance Software Department, AT&T Bell Laboratories.

Peter G. Jessel, Ph.D.'72, writes from Scarsdale, N.Y., that he moved to New York to join McKinsey and Co. as the industry consultant for information technology.

Peter B. Miller, S.M.'75, has joined with his former boss at Lotus Development Corp., Mitchell D. Kapor, '81, to form a new company called ON Technology, Inc., in Cambridge. Its goal will be software that makes computers "compatible with the way people actually communicate and think," Kapor told a start-up press conference. Miller will be president, Kapor chairman of ON.

The keynote address given by Patrick H. Winston, Ph.D.'70, director of the M.I.T. Artificial Intelligence Laboratory, at the second Australian conference on expert systems in 1986 has now been published as the first chapter in *Applications of Expert Systems* (Addison-Wesley, 1987). The collection, including Winston's "Artificial Intelligence and Expert Systems," was edited by J. Ross Quinlan of the New South Wales Institute of Technology.

Two alumni on the Lincoln Laboratory staff were speakers at Boston IEEE programs late last year. "Signal Processing for a Space-Based Radar" was the topic of Anthony E. Filip, Ph.D.'73, head of Lincoln's Sensor Processor Technology Group. And Harold M. Heggstad, Sc.D.'69, spoke on applications of expert systems in Department of Defense communications control. Heggstad is assistant leader of Lincoln's Machine Intelligence Technology Group, Computer Technology Division. Another IEEE Boston speaker was David J. Edell, associate professor of health sciences and technology at M.I.T., who described topics in neural information transducer technology.

"Conventional and High-Temperature Superconductors" is the title of a short course to be given at an April meeting of the Materials Research Society, Reno, Nev., by Associate Professor Terry P. Orlando of M.I.T. and Robert E. Schwall of the Francis Bitter National Magnet Laboratory. . . . **Duncan C. Watson**, Ph.D.'75, writes, "In June I married Mary Ellen, nee Kovalanchik, a music teacher with the Garden Grove School District. We are living in happy suburban (Huntington Beach, Calif.) chaos with one dog, two rabbits, three cars, one house, and a surplus condo. I have been working for Rockwell International as a systems engineer since 1979." . . . **Charles H.R. Camp**, S.M.'48, writes from Kingston, Ontario, Canada, "A 'reunion' weekend in August 1987 with **Edwin S. Rich**, S.M.'48, and **Lachlan F. Blair**, '48 (XI), and their wives at our summer retreat on Buck Lake, 25 miles north of Kingston. Ed is retired from Mitre Corp. and lives in Maine; Lachlan is teaching (and has a consulting practice) at the University of Illinois."

A decade ago his students in technology and society were interested in energy problems; today they're motivated by studying about space—and by models of epidemics, AIDS in particular. Whatever the subject, that kind of interest in applications is essential, says **John G. Truxal**, Sc.D.'50, if the concepts of technology are to be brought to liberal arts students. That's been Truxal's goal for a decade and more as head of the Department of Technology and Society at the State University of New York at Stony Brook. He still doesn't know how well it's working. "What I really would like to measure," Truxal wrote in *Engineering Education*, "is the change in students' attitudes, the extent to which they think about and discuss the course outside the classroom, and how it affects their behavior from now on."

"We can't just stand over people with a whip and tell them, 'Create, or else.' It won't work," says **Robert N. Noyce**, Ph.D.'53, founder of Intel Corp., in a new IEEE book, *Engineering Excellence*, edited by Donald Christiansen, publisher of IEEE's *Spectrum* (IEEE Publications, Piscataway, N.J., \$32.75). "The process of innovation depends on our ability to give our innovative people breathing room and leave them alone so that their ideas can eventually bear fruit," writes Noyce.

From UNISYS Corp. has come a doctoral fellowship fund for M.I.T. graduate students pursuing teaching careers, and **Jennifer R. Melcher**, '83, is the first beneficiary. UNISYS resulted from the merger of Burroughs Corp. and Sperry Corp.; funding for three students will eventually be available. Ms. Melcher is completing her doctoral thesis on auditory-evoked electric potentials at the Peabody Laboratory of the Massachusetts Eye and Ear Infirmary.

VI-A Internship Program

Congratulations to **Robert E. Anderson**, '62, picked to be the new president and chief executive officer of GenRad, Inc. He succeeds another VI-A graduate, **William R. Thurston**, S.M.'48, who moves up to become GenRad's first chairman. Both gentlemen had their VI-A assignments at General Radio Co. (as GenRad was then known). We wish them both well in their new responsibilities.

It was with sadness that I report the sudden death of **Erland P. van Lidth de Jeude**, '76, on September 23, 1987. This came to my attention in Arthur Carp's report as class secretary in the January issue (p. MIT 34). When he was on VI-A I visited Erland several times during trips to G.E., Pittsfield, accompanying their VI-A faculty advisor. It was during a summer assignment there that Erland became interested in Greco Roman wrestling and later placed fifth in national competition. He had a great singing voice—my first introduction to him was when, as a freshman, he sang Gilbert and Sullivan. More on his life is given in the above-mentioned article, along

with information on the establishment of a trust fund for his son's education.

Director **Kevin O'Toole**, '57, tells me our VI-A seniors are continuing to do superbly well in gaining admission to the graduate phase of the program. Of 96 current VI-A seniors the department has admitted 83 (86.4 percent) to continue on to graduate study. Of 29 of these given unrestricted "regular" admission, 12 (or 41.4 percent) were also awarded the coveted "early admission" with guaranteed financial support. These statistics bear out the continuing high quality of students being selected to participate in the VI-A Internship Program.

By the time this is in print, the annual selection of a new VI-A class will be under way. The annual orientation lecture is to be given by Director O'Toole on February 3, with the annual business meeting, dinner, and company interviews occurring February 29 through March 2, 1988. Mr. O'Toole anticipates the new class size will remain at 90.

The complement of participating companies will remain almost the same this year. With the sale by Schlumberger of Fairchild, assignments at the Fairchild Palo Alto Research Center and the Fairchild South Portland, Maine, facilities will be phased out. Added for the first time will be assignments at Schlumberger's Research Center, Ridgefield, Conn.

Last year's purchase of RCA by the General Electric Co. resulted in the transfer of RCA's David Sarnoff Laboratories to Stanford Research Institute (SRI). The David Sarnoff Research Center will, however, remain on the program in place of RCA. We'll be reporting to you on the final selection process in one of the next issues.

Over the holiday season we do not experience as many visitors to the VI-A Office as during other times of the year, and this held true this year. We did receive our usual lovely Christmas cards with photos and messages bringing us up to date on your lives. For these remembrances we thank you!—**John A. Tucker**, Special Assistant to the Department Head for VI-A and Lecturer, Room 38-473, Cambridge, MA 02139.

VII BIOLOGY

Florence J. Spring, S.M.'37, of Big Horn, Wyo., died in an automobile accident on September 27, 1987. Spring first came to Wyoming in 1966 to be executive director of the state Girl Scout Council; later she served as associate dean of students at Sheridan College, Sheridan, Wyo., and as a coordinator of volunteer services in Cheyenne. She retired to Big Horn in 1979 to pursue her interests in conservation, becoming co-founder of the Big Horn Audubon Society and first president of the Audubon Council of Wyoming.

David Baltimore, '61, director of the M.I.T. Whitehead Institute for Medical Research and 1975 Nobel Prize winner in physiology and medicine, was one of 75 attending a Swarthmore College fundraiser at the home of Edwin and Rosalind Whitehead. . . . **Donald P. Lombardi**, S.M.'69, writes from Boston that he is director and vice-president of the Chitin Co., Inc., Cambridge, a new venture in the biomaterials field.

Elizabeth Maclean Slayter, Ph.D.'60, scientist, author, editor, and former faculty member at M.I.T. and Brandeis, passed away in Lincoln Center, Mass., on July 11, 1987. Her interest in virology led to a study for the Federal Housing Authority on ground water contamination by viruses, and she is credited with deducing the structure of one of the smallest viruses, Phi x174. An accomplished author, she wrote *Optical Methods in Biology* and *Principals of Optical and Electron Microscopy*. An active member of the Lincoln Center community, she taught Sunday School and was a founding member of the Lincoln Public Library's book discussion group. She was an activist for peace, population control, and special-needs children.

Making Time Stand Still

As Institute Professor Emeritus Harold E. Edgerton, Sc.D.'31, approaches his 84th birthday on April 6, 1988, two unique tributes in print: "Doc' Edgerton: The Man Who Made Time Stand Still," by Erla Zwingle in the *National Geographic* (October 1987) and *Stopping Time: The Photographs of Harold Edgerton*, a "coffee-table" book published for the 1987 holiday season by Harry N. Abrams, Inc., New York.

Zwingle credits Edgerton with "profoundly changing the way we see the world" through his high-speed flash technology and its many derivatives. And she emphasizes "Doc's" pragmatism by capitalizing on his favorite expression: "Let's get out of here. Do something useful for a change."

Stopping Time is a collaboration between the publishers and Gus Kayafas, '69, whose Palm Press is the official custodian of Edgerton's photographs. There is a biographical essay by Estelle Jussim, a well-known historian of photography, and a complete bibliography by Marie Dagata and "Doc's" long-time assistant, Jean Mooney. But the stars of the book are 138 of Edgerton's pictures, reproduced from what Kayafas says are "the best Edgerton prints ever made" and captioned with Kayafas' own comments and recollections.

Kayafas says he came to M.I.T. "to study physics and how the world worked." But it took Edgerton to give him "the real experience of inquiry."—J.M. □



It's not often that two major publishing events salute a single academic with a single photograph in a single month. But it happened late last year to Professor Emeritus Harold E. Edgerton, Sc.D.'31. His photograph of bullet penetrating apple was chosen for the dust jacket of a retrospective book and the opening of a National Geographic tribute.

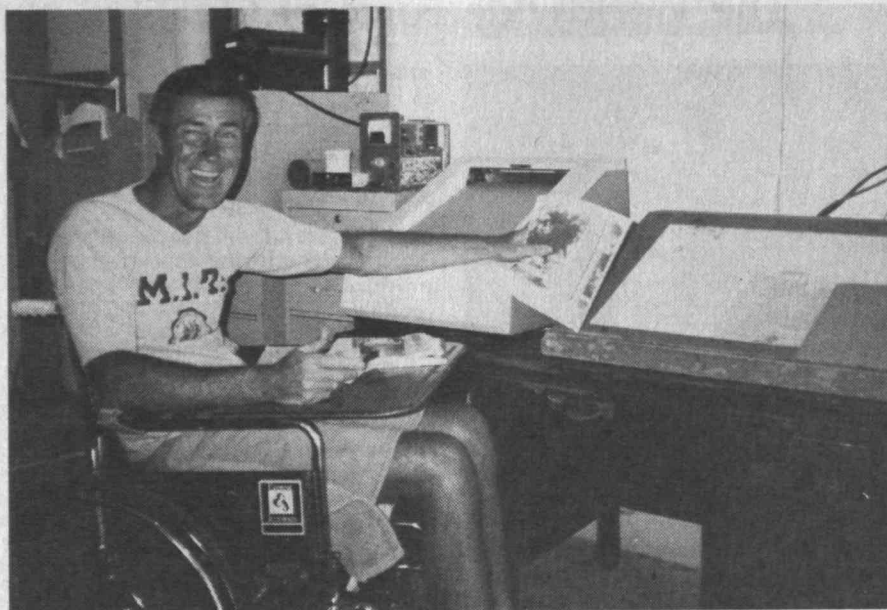
The World's Weather Comes Into this Garage

Behind the picture of the Chernobyl reactor's nuclear "distrail" in our October issue (page MIT 57) lies a story about Henry W. Brandli, S.M.'65, who's one of the country's experts in satellite weather photography. The Air Force had asked Brandli to look at the picture when they were unable to figure out the meaning of the curious cloud formation.

Brandli answered the Air Force's question while sitting in his \$200 satellite photo laboratory in Palm City, Fla., where his hobby and business combine as he picks weather satellite photographs out of the sky to process and analyze.

Brandli developed his expertise in deciphering satellite photographs in Vietnam, where such pictures were the only way the Air Force had for learning about the weather—especially vital for air strikes over North Vietnam. Brandli was assigned as weather satellite special projects officer, in charge of 10 technicians and \$30,000 worth of equipment.

After the war, he worked at the Air Force Eastern Test Range and the Kennedy Space Center until worsening multiple sclerosis forced retirement from active



"High-tech doesn't have to be expensive," says Henry W. Brandli, S.M.'65, sitting in front of his \$200

satellite photo receiving system in his Florida garage. "Every school should have something like this."

duty (with the rank of lieutenant colonel). But weather pictures were his passion, and he turned his garage into a satellite laboratory where he can receive weather photographs from both U.S. and foreign satellites.

"I don't think there is anyone in this country getting Soviet stuff this clean,

and I'm getting it right now at my house," he told a recent visitor from *Paraplegia News*.

Brandli is busy as a consultant and lecturer—and a frequent contributor of satellite photographs to journals ranging from *Technology Review* to *Aviation Week*. □

The death's of seven other alumni have been reported to the Alumni Association. No further details are available: **Charles A. Cogan**, S.M.'34, in Fort Myers, Fla., on May 10, 1987; **Arnold L. Johnson**, S.M.'39, in Arcadia, Calif., on October 15, 1987; **Richard Mungen**, S.M.'47, in Tulsa, Okla., on June 8, 1987; **Samuel O. Amponsah**, S.M.'79, in Mattapan, Mass., on October 16, 1987; **Ho Y. Whang**, Sc.D.'61, of Paramus, N.J., on October 6, 1986; **John P. Cogan**, Sc.D.'36, of Houston, Tex., on August 14, 1987; and **Donald B. Broughton**, Sc.D.'43, of Evanston, Ill., on December 2, 1984.

XI URBAN STUDIES AND PLANNING

From Cambridge, **Gail Kendall**, M.C.P.'79, writes, "My daughter, Sophie Anna Friedman, was born on June 18, 1987. I'm doing a little consulting work and am managing a small office building that I developed. But mostly I'm having a great time being a mother!" . . . From **Alan Sager**, Ph.D.'79, of Brookline, Mass.: "My 'time banking' plan to mobilize volunteers to aid disabled older citizens is being tested in a number of sites. Meanwhile, I'm working on a plan to finance and deliver health care for all citizens of Massachusetts without increased spending."

Owen Martinez-Sandin, M.C.P.'60, writes that after retiring from government service in Puerto Rico he has started a second career as university planner at the Interamerican University of Puerto

Rico; there are now 40,000 students on several campuses, and expansion plans include a new campus at Bayamon and a new law school at Santurce.

Beginning next summer, two \$12,500 fellowships will be available annually for study in the Center for Real Estate Development's 12-month master of science curriculum. The fellowships are intended for members of 12 minority groups underrepresented at M.I.T.—black Americans, Mexican Americans, Puerto Ricans, and American Indians. **Donna D. Berman**, M.C.P.'72, has been named director of marketing at Index Technology Corp., Cambridge. Berman was formerly director of marketing communications for Bolt Beranek and Newman Software Products Corp. . . . **Annie Bloch**, '75, reports from Paris, "I am working in a research laboratory at the Ecole Nationale des Ponts et Chaussees, France. My present research topic is individual and organizational learning and the shift to a learning society." . . . **Robert S. Schwartz**, M.C.P.'68, received the Washington, D.C. Mayors Architectural Awards Citation for the Logan School Condominiums, an adaptive re-use project.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

A newspaper clipping reports that the husband of **Frances S. Hotchkiss**, Ph.D.'82, has been called to serve as minister to the Unitarian Society of New Haven, Conn. Ms. Hotchkiss teaches

oceanography at Florida Atlantic University, where she is a specialist in waves and currents in the Gulf Stream.

Stewart Nozette, Ph.D.'83, founding vice-president of the Large-Scale Programs Institute and senior research fellow at the IC2 Institute, Austin, Tex., is co-editor of *Commercializing SDI Technologies* (Praeger, 1987, \$39.95). It's a collection of essays that together survey the impact of SDI on technologically based industries. Nozette, who has a faculty appointment in the Department of Aerospace Engineering at the University of Texas, concludes that SDI has "great potential to produce commercially valuable technology." But he admits that controversy will continue on "whether the SDI is the best approach to producing the desired commercial results." **Hans Mark**, Ph.D.'54 (VIII), of the University of Texas is even more optimistic: like other efforts to push back the frontiers of knowledge, he writes in a foreword, the "SDI program will almost certainly have major impact on the economy."

Francis W. Murray, Ph.D.'60, writes from Pacific Palisades, Calif., "In December 1986 I retired from the Rand Corp. after 20 years of service, but continue as a consultant for Rand and elsewhere." . . . **Bonnie Buratti**, S.M.'77, reports, "Since receiving my doctorate from Cornell, I've worked as a space scientist at the Jet Propulsion Laboratory in Pasadena, Calif., on NASA's planetary missions. I'm expecting a third child in March to join Nathan (age five) and Reuben (age two-and-a-half)."

Three deaths have been reported to the Alumni

The Worldwide Force of Quality



The quest for quality in goods and services should inspire Japanese-American cooperation, not the "nipponneurosis" he sees in the United States today, says Armand V. Feigenbaum, Ph.D.'51.

Nipponneurosis—the idea that Japan somehow holds a “franchise on the production of quality products and services”—is a dangerous myth, says Armand V. Feigenbaum, Ph.D.'51 (XIV), president of General Systems Co., Inc., Pittsfield, Mass. It engenders protectionism and a sense of competition. And they in turn jeopardize a developing interdependence between the U.S. and Japan that Feigenbaum calls “this generation's best hope for global stability, economic growth, and a better life for all.”

Quality belongs to no single nation, says Feigenbaum in the first issue of a glossy new magazine called *The Quality Review* from the American Society for Quality Control late last year. It's true that

principles of quality management began to emerge in the U.S. in the 1920s and 1930s and flowered here in the 1950s with the work of consultant W. Edwards Deming and Feigenbaum himself, who first published his best-selling *Total Quality Control* in 1951. But the Japanese were pioneers in employing these concepts to produce automotive and electronic products that have been spectacularly successful worldwide.

On the other hand, says Feigenbaum, don't forget that U.S. industry used the same principles, too, to achieve world-standard aircraft, electrical equipment, even hamburgers and jeans.

Indeed, writes Feigenbaum, quality principles “have been an elevating force on living standards not only in Japan and America but throughout the world.”

Even more important is the lesson that is recognized as “the basic business approach for bringing about quality results: Business effectiveness today depends on human motivation and organizational coordination, not on the subordination of the human to the machine and excessive specialization.”

The need now, says Feigenbaum, is to “provide for more thoroughness and continuity in the way American and Japanese managers learn about each other's business processes.

“In this era of interdependence, it has become almost as important for them to learn to deal effectively with each other as it is for them to carry on business in their own countries,” he writes. “Together, the United States and Japan have the resources to make free trade work and improve the quality of life on this planet.” □

Association, with no further details available: Captain **Harold Payson, Jr.** S.M.'63, who was associated with Roger Williams College, Bristol, R.I., died in Bristol in September 1987; **James W. Osmun**, S.M.'37, died in Boca Raton, Fla., in September, 1982; and **Alfred C. Molla, Jr.**, S.M.'61, of Satellite Beach, Fla., died on August 9, 1985.

XIII OCEAN ENGINEERING

John C. Scalzo, Oc.E.'73, has been promoted to the rank of captain in the navy; as of last fall he expected an assignment as planning officer at the Philadelphia Naval Shipyard next summer. . . . Professor **Henry S. Marcus**, S.M.'67, is spending part of a sabbatical from the department at M.I.T. doing research in the office of the assistant secretary of the navy for shipbuilding and logistics.

Lieutenant **Kevin Carpenter**, S.M.'82, is the engineer officer of the Coast Guard's U.S.C. *Tahoma*, a new cutter delivered in August 1987 and based in New Bedford, Mass.

From New Orleans, **Pabitra Makerji**, S.M.'80, writes that he is working as a senior consulting naval architect for McDermott, Inc.; he describes his work: “formulation of mooring dynamics for offshore vessels and the hydrodynamics and motion responses of very large offshore crane vessels with heavy hanging loads on the crane hook.” . . . **James J. Burgess**, Ph.D.'85, has completed his first year as a member of the technical staff in the Undersea Systems Development Laboratory at A&T Bell Laboratories. His work focuses “on the study of underwater vehicle systems and the mechanics of undersea cable deployment.” Three alumni report recent retirements. **Francis A. Packer, Jr.**, N.E.'51, is an adjunct professor of mathematics at Kean College of New Jersey, Union, N.J.; “the part-time work is just the right pace for me,” Packer writes, “and the contact with college students is enjoyable.” . . . After leaving the Coast Guard four years ago, Captain **Barry C. Roberts**, N.E.'63, is “having the time of my life” as vice-president (operations) for ELS, Inc., Washington, D.C.; the firm specializes in technical and integrated logistics support, chiefly for

NAVSEA. . . . “Since my retirement in 1980,” reports **William N. Price**, S.M.'41, from Washington, D.C., “I have been a full-time volunteer working to provide accessible housing and support services to physically disabled, mentally normal adults.”

Henry J. Nardone, N.E.'52, Trident program manager of Electric Boat, Groton, Conn., was the featured speaker during the annual Westerly, R.I., Columbus Day parade last year. Nardone, a long-time community activist, has served as a member of the Rhode Island Board of Governors for Higher Education since 1981 and was a member of the Westerly School Committee for 17 years, serving for various terms as its chairman and vice-chairman.

From Pepperell, Mass., **Kevin White**, S.M.'74, writes that he joined Warren Communications in 1984 as director of research and development. In 1986 he was promoted to director of engineering, working in the development of power conversion products using high frequency switching technology.

Donald P. Courtsal, S.M.'56, reports from Pittsburgh, Penn., “Retired from full-time employment in 1985. Now working part-time as financial consultant for Allegheny Financial Group, a registered financial planning firm. Wife Frances works part-time as writer and editor. Older son is in Oregon. Younger son is in third year of medical school.”

Richard Riley, S.M.'46, writes from Des Moines, Ia., “My wife, Elizabeth, died in January 1983 and I remarried later that year. On retirement from Iowa Resources in January 1985, Betty and I took a ‘slow boat to China’—a freighter cruise out of New Orleans to Dalian. We went overland in China, coming out at Hong Kong, then flying to Manila to rejoin the ship . . . Borneo, Sumatra, Singapore, Indonesia, Japan, and home—91 days in all. What a way to start one's retirement! During the winter of 1985-86 we flew to New Zealand, touring four weeks by car, and then on to Australia for two months, mostly by car, but flew to Alice Springs and Perth. A pair of delightful countries. Winter last year was another freighter trip. This time to the Eastern Mediterranean out of New Orleans, Charleston, and Baltimore. Christmas and New Year's at sea were a different way to go. Israel, Turkey, Egypt, and Yugoslavia made for an interesting winter—61 days in all. God willing, we plan the Western Mediterranean European coast this year, driving and poking along on our own.”

Henry (Hank) Moravec, S.M.'60, writes from Port Orchard, Wash., “Between consulting jobs, I'm trying to see how high I can get this old (55) body. Recently, I've climbed the seventh, fifth, and third highest mountains in North America (19,800') and Chimborazo (20,700') in Ecuador. My next effort will be Aconcagua (22,800') in Argentina, the highest in North and South America.”

. . . Rear Admiral **John F. Claman**, N.E.'69, has been named supervisor of shipbuilding at the navy submarine base in Groton, Conn. Formerly Claman served as program manager for the Attack Submarine Program Office at the Naval Sea Systems Command, Washington, D.C. His distinguished naval career, has also included assignments in ship repair; ship research, development, and acquisition; and on the chief of naval operations' staff.

(Charles) Cedric Ridgely-Nevitt, S.M.'40, associated with the Webb Institute of Naval Architecture, Glen Cove, N.Y., passed away on May 5, 1986; no further details are available.

XIV ECONOMICS

Joseph E. Stiglitz, Ph.D.'66, professor of economics at Princeton, is the author of “Learning to Learn: Localized Learning and Technological Progress, a chapter in a collection on *Economic Policy and Technological Performance* published late last fall by Cambridge University Press for the

Centre for Economic Policy Research.

Edward Moscovitch, Ph.D.'66, economist, columnist, and former state budget director, has been appointed executive director of the nonpartisan Massachusetts Municipal Association (MMA). Prior to joining the MMA, Moscovitch was director of regional economics at Charles River Associates, Boston. . . . **Richard K. Lyons**, Ph.D.'87, writes from New York, "I am currently teaching international business in the Graduate School of Business at Columbia University." . . . **Bernard S. Friedman**, Ph.D.'71, is currently vice-president—research, Hospital Research and Educational Trust, Chicago, Ill.

XV MANAGEMENT

From New York, where he was working as new products marketing manager for Reuters, **Robert Clyatt**, S.M.'85, reported plans to transfer to the company's Tokyo office early in 1988. . . . **Richard Pighossi**, S.M.'65, is managing director of Elders Pica Pte., Ltd., Singapore, providing investment banking and financial services in southeast Asia; the firm is part of the Elders IXL Group of Australia. . . . Back in Japan, **Yukio Ito**, S.M.'78, writes from Urawa City, Saitama Prefec.: "After working for the Asian Development Bank, an international aid organization, at its headquarters in Manila for more than three years, I returned to the Mitsui Bank, Tokyo, where I used to belong. Instead of the job in agroindustries-related project finance, I now deal with aggregate trading firms." . . . **John H. Roberts**, Ph.D.'84, Mosman, N.S.W., has been named a tenured associate professor in the Australian Graduate School of Management, University of New South Wales; he is a fellow of the Australian Marketing Institute and the New South Wales representative to the American Harkness Fellowships.

Assen Nicolov, S.M.'77, is chairman and CEO of Oceantrawl, Inc., New York, and therein lies a story: "Oceantrawl," writes Nicolov, "is entering the 'surimi' industry. Surimi is a Japanese fish paste produced on board factory trawlers at sea and used as raw material in the manufacture of a variety of seafood products. We will start production of surimi in the waters of Alaska in the middle of 1988 aboard our new vessel, the *F/T Northern Eagle*, the largest factory trawler in the United States."

Lawrence P. Schoen, S.M.'72, is a director of Midland Montague Metals, New York, a wholly owned subsidiary of Midland Bank Plc. . . . **Perry D. Cohen**, Ph.D.'79, is president of Unison Corp., Washington, D.C., a consulting firm specializing in planning and information management for health and environmental programs. . . . **John D. Rudolph**, S.M.'73, is newly arrived in Cincinnati to be vice-president—optical components at U.S. Precision Lens, a subsidiary of Corning Glass Works. . . . **Huntington D. Lambert**, S.M.'85, Denver, is now a member of the Technology Alliances Group of U.S. West Advanced Technologies, the R&D subsidiary of U.S. West; his assignment is to acquire technologies needed by the company, by purchase or joint venture.

From Old Greenwich, Conn., **Richard M. Bartholomew**, S.M.'62, writes, "After having been in my own business, I joined IBM's corporate telecommunications staff four years ago as an advisory planner. Recently I moved to industry marketing, where I am helping develop IBM's hardware/software strategy in investment management and mortgage-backed securities."

Mitchell Kapur, '81, who resigned as founding chairman of Lotus Development Corp. in 1986, is now chairman of his own new start-up company, ON Technology, Inc., Cambridge; he's also a director and major investor in GO Corp., San Francisco. . . . Two scholarships, each worth \$2,000, from the Boston Chapter of the Society for Information Management have come to two Sloan School graduate students, **Bradley A. Feld**

and **Felix Lin**. The scholarship program, under which five grants were made to students from New England, is designed to encourage advanced education in the field of management information systems.

Richard J. Wolak, S.M.'83, of Norwich, Conn., has joined United Community Services, Inc., as business manager. Previously Wolak served as manager of finance and administration at Pressure Pak Containers, East Hampton, Conn. . . .

Peter Kozel, Ph.D.'73, senior vice-president and chief economist for Shawmut Bank, Boston, spoke last November at a forum sponsored by the North Central Massachusetts Chamber of Commerce in Fitchburg. . . . **Ronald J. Zlatoper**, S.M.'75, is currently assigned as the chief of staff, Commander Seventh Fleet. Zlatoper is living in Yokosuka, Japan, with his wife Barry Lane and their two children, Mike and Ashley. . . . The software consulting practice of **David H. Bowen**, S.M.'78, has entered its third year in San Jose. Bowen reports that the practice is growing steadily, and he has introduced a newsletter for software chief executive officers and marketing executives called *Software Success*. Bowen writes that daughter Kim and son Michael "are becoming computer whizzes in their own right. Kim is the third fastest keyboardist in her school's computer laboratory, and Michael regularly claims first place at a local video arcade. Mom (Susan) has retired from the medical field and provides back-up in the consulting business doing administration, marketing, management, and newsletter editing."

Bruce A. H. McFadden, S.M.'75, writes, "On returning from Europe in September 1986, where I had been managing director of General Electric Silicones Europe, I joined Graco, Inc., of Minneapolis as vice-president of the Fluid Handling Division." . . . **Michael Halloran**, S.M.'83, brand manager for Proctor and Gamble, writes from Cincinnati that he married Kelly Trouille on February 14, 1987, and since then they have bought a new home.

To Professor **Jay W. Forrester**, S.M.'45, the \$10,000 Agricoltura 2000 Award for 1987, for "contributions to the advancement of environmental studies." The award is made by Agricoltura 2000, the annual Italian fair of technological innovations and services for agriculture.

The Alumni Association has been advised of the death in London of **Ahmes Khalifa**, S.M.'68, on July 25, 1987; details are not available.

Sloan Fellows

Carroll M. Martenson, S.M.'54, has moved east to become president and CEO of Esterline Corp., Darien, Conn. He continues as chairman of Criton Technologies, a Seattle-based aerospace and electronics company of which he was formerly (1971 to 1985) CEO. Earlier he was a group vice-president at Textron, Inc., following naval service in which he rose to the rank of lieutenant commander. . . . From Paris, **David Znaty**, S.M.'79, writes that he is professor of management information systems at the Ecole Centrale des Arts et Manufactures, active as a consultant in hardware and software for U.S. companies' European operations, and an expert witness in cases involving computer hardware and software for the Cours d'Affel de Paris.

John T. Pettit, S.M.'58, died in Pasadena, Calif., on December 29, 1986; no further details are available.

XVI AERONAUTICS AND ASTRONAUTICS

Before he took his new job as assistant director and science writer in the M.I.T. News Office, **Eugene Mallove**, S.M.'70, finished a new book; *The Quickening Universe* (St. Martin's, 1987, \$18.95) draws its title from Mallove's concept that "the cosmos has come to life—quicken—and is now examining itself to discover meaning in its origins

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and destiny."

When the sticky question of where to put its much-needed new airport arose, Sydney, Australia, drew on M.I.T. for four members of an expert Australia-U.S. team. It worked: the airport is now under construction, and the team has been cited by the Australian Institute of Engineers for its Engineering Excellence Award. The M.I.T. experts included John de Monchaux, Australian by birth, who is dean of the School of Architecture and Planning; Professor **Richard de Neufville**, Ph.D.'65 (I), head of the Program in Technology and Policy; Professor **Amedeo R. Odoni**, Ph.D.'69 (VI), codirector of the Operations Research Center; and Professor **Robert W. Simpson**, Ph.D.'64, director of the Flight Transportation Laboratory. De Neufville received special notice for his use of decision analysis to help define government strategy.

XX APPLIED BIOLOGICAL SCIENCES

Hillel J. Chiel, Ph.D.'80, writes, "After postdoctoral work in neurophysiology at Columbia University's College of Physicians and Surgeons and at AT&T Bell Laboratories, I have been appointed assistant professor in the Department of Biology at Case Western Reserve. So my wife Liz and our six-month-old son Benjamin are on their way with me to Cleveland."

Sergio Miranda de Cruz, S.M.'81, has two offices: he is assistant professor of food engineering at the University of Campinas, Brazil, and industrial development officer for the United Nations Industrial Development Organization, whose headquarters are in Vienna. . . . We report belatedly an honor to Associate Professor **Alexander M. Klibanov** of M.I.T.: the 1986 Leo Friend Award in Chemical Technology, sponsored by the American Chemical Society's Division of Industrial and Engineering Chemistry.

XXI HUMANITIES

The seven sections of the department that offer the undergraduate humanities major at M.I.T. now have increased autonomy: the Course XXI office is being phased out, says Dean **Ann F. Friedlaender**, Ph.D.'64, leaving the sections to take charge of the programs of their undergraduate majors. The sections are history, literature, foreign languages and literatures, anthropology and archaeology, music and theater arts, writing, and science, technology and society.

As "a signal to the entire Institute of how much we value (her) contributions to improving undergraduate education," in the words of Provost **John M. Deutch**, '61, Dean Friedlaender has been designated, effective last July, the Class of 1941 Professor. The professorship was given by the class at its 40th reunion to "encourage innovative and imaginative teaching"; Friedlaender holds

faculty appointments in civil engineering and economics, reflecting her special interest in public finance and transportation studies.

A new Ph.D. program at M.I.T. in the history and social study of science and technology has been approved by the faculty and will accept its first students next fall. Offered by the Program in Science, Technology, and Society and the faculties of history and anthropology/archaeology, the program will admit no more than four students a year who will choose between two tracks: the history or the social study of science and technology.

Theodora June Kalikow, S.M.'70, formerly dean of the College of Arts and Sciences at Northern Colorado University, is now chief academic officer at Plymouth (N.H.) State College. Even before she finished her degree at M.I.T., Kalikow was teaching philosophy at Southeastern Massachusetts University, where she was assistant to the president for two years and chairman of the Philosophy Department for three years.

TECHNOLOGY AND POLICY PROGRAM

Winslow Hayward, S.M.'81, writes, "Fran and I had a bountiful Thanksgiving dinner with Sue and **Roger Kilgore**, S.M.'81, and **John Newman**, S.M.'82, and friend. All are well in Washington, D.C." . . . **David W. Cheney**, S.M.'83, has been on leave (since December 1987) from the Congressional Research Service, doing a research fellowship at the Institute for Policy Science at Saitama University in Japan.

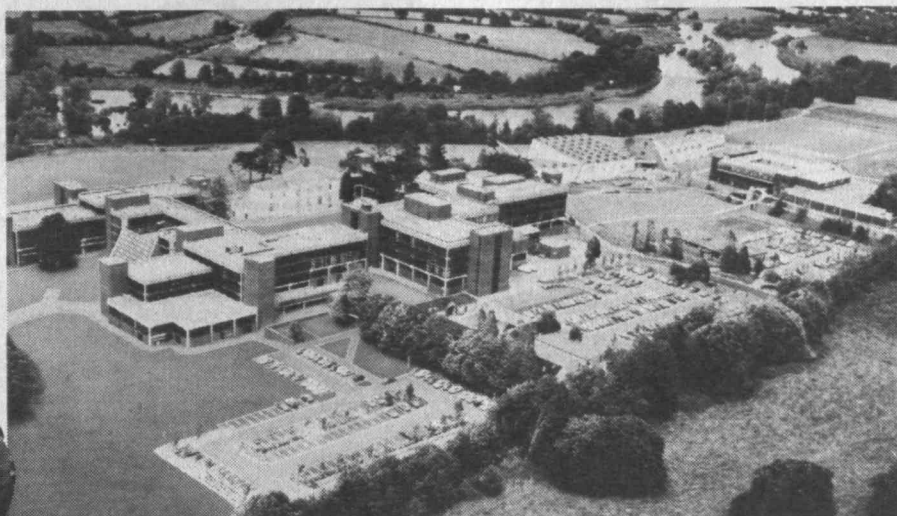
From Oakland, Calif., **Kent W. Hughes**, S.M.'85, writes that he is continuing to jet around the world in his current capacity as technology consultant for Pacific Bell. Late last year he attended an M.I.T. Club of Hong Kong meeting where Paul and Priscilla Gray were addressing potential students. Hughes also met with friend **Phillip Ng**, S.M.'85, who now resides in Hong Kong with his wife and daughter.

Jeanne Briskin, S.M.'83, is now in charge of the EPA Task Force that is preparing standards for lead in water. . . . **Matthew Buresch**, S.M.'85, has relocated to Washington and is employed by I.T. Power. He is working with renewable energy markets and economic evaluation. . . . **Roger Kilgore**, S.M.'81, has been promoted to vice-president and partner in GKY Associates, environmental planners and designers, Springfield, Va. . . . **Franz Neubacher**, S.M.'83, is currently in charge of waste management for the Austrian Ministry of the Environment. He recently visited the U.S. for two weeks on an official mission.

John Stewart, S.M.'80, is president of Effective Software, Inc., Washington, D.C. . . . **Joan DoPico Winston**, S.M.'82, is a policy analyst with the U.S. Office of Technology Assessment where she had just completed a highly praised study of computers in government. . . . **John Zilber**, S.M.'83, is now the features editor of *Mac User Magazine* in San Francisco.—**Richard de Neufville**, Chairman, Technology and Policy Program, Rm. 1-138, M.I.T., Cambridge, MA 02139.

"The European M.I.T." on the Banks of the Shannon

By Karen Birchard



The Plassey Technological Park in Limerick (above) is a key link between Ireland's National Institute of Higher Edu-

cation (NIHE) and industry. (Left) An NIHE student setting up an experiment in an anechoic chamber.

It's a rare day indeed when a university president admits publicly that his institution has openly plagiarized another. But the copied institution—in this case M.I.T.—is always complimented.

The institution that has so blatantly modeled itself after M.I.T. is now one of the British Isles' leading technological universities, Ireland's National Institute of Higher Education (NIHE), located on the picturesque banks of the River Shannon. Edward Walsh, its president, sits in his office on the second floor of the nineteenth century Georgian mansion that was once the only building on NIHE's campus, reminiscing about the launching of NIHE back in 1972.

"When we first started, there were just two of us in this house. One day a taxi drew up by the front door and a guy climbed out. It was our first faculty member—Peter Wolf from the Sloan School. So, in keeping with our mandate that we were to pattern ourselves after M.I.T., it was a good omen that the first academic to darken our door was from M.I.T.," Walsh chuckles.

Prior to the start-up of NIHE, Ireland was primarily an agricultural country with very little in the way of a technological tradition. In 15 years that situation has been reversed. "It's a funny situation we find ourselves in. We've leapfrogged from no engineering to having some of the most sophisticated in the world," says Walsh. He himself is a nuclear engineer who returned to Ireland to supervise the setting up of the

new university after having taught in the States for ten years.

"M.I.T. has demonstrated to the world that excellence can go hand in hand with technology targeting. M.I.T. has always targeted strategic areas, producing both fundamental research and very applied work, so we said we'd do the same thing," he continues.

Walsh was the architect for the development of the adjacent Plassey Technological Park, which has established close links between industry and the university. John McGinn, the director of cooperative education at NIHE, points out that it was imperative to have Ireland's first science park as close to the university as was physically possible because it encouraged focused integration.

"For most companies, the opportunity to assess and work with promising graduates and faculty is one of the most worthwhile aspects of collaborative research," McGinn says. He cites the American example of Symbolics Corp., a manufacturer of AI-oriented computers located a few blocks from M.I.T. so it could also keep up with the latest advances in AI. "According to the company, being even two or three miles away would have been too far," explains McGinn, who reinforces the Irish university's belief that an important aspect of M.I.T.'s excellence is its close ties to industry.

Having the facilities of NIHE next door was one of the factors that influenced Wang when it chose to locate its

European headquarters in Ireland. Bill Hennebry, Wang's managing director in Ireland, is enthusiastic about the partnership that has evolved between his company and NIHE. "We both win as we work together. Ireland has a superb educational system and the students coming out of NIHE are world-class."

NIHE is trying to develop closer links with the Institute now that it is a full-fledged university. John O'Connor, NIHE's money man, was very impressed with M.I.T.'s Industrial Liaison Program on a recent visit to Cambridge, and he wants to increase the contacts between NIHE and M.I.T.

President Walsh would also like to see more contact—even if it's only a brief visit from M.I.T. faculty and students who might have included Ireland in holiday plans. "We're the nearest European university to Boston—only a five-hour plane ride. Once you land at Shannon, NIHE is a mere 20 minutes down the road.

"We're doing more and more social research along with technological impact studies. And the Irish Peace Institute has its headquarters here," says Walsh. And then with a wide smile he adds, "There's no doubt now. We are becoming Europe's M.I.T." □

KAREN BIRCHARD former science reporter for CBC-RADIO in Canada, held a Vannevar Bush Fellowship in Science Journalism at M.I.T. in 1983-84. She is now a freelance writer based in Ireland.



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Walter K. MacAdam
August V. Mackro
Gerald S. McMahon
Harold F. Miller
John A. Myers
Roman L. Ortynsky
James F. Patterson
Lawrence G. Peterson
Edward L. Pratt

1937
Frederick J. Altman
Charles M. Antoni
William O. Arnold
E. L. Bartholomew, Jr.
Winthrop D. Comley
John C. Gibbs
Daniel J. Hanlon, Jr.
Charles F. Healey
William H. Healey
Curtis Hillier, Jr.
Richard C. Hutchinson
Charles R. Kahn, Jr.

The following alumni/ae made individual gifts to the 1987 Alumni Fund of \$250 or more, exclusive of corporate matching gifts, and qualify as Great Dome Associates. Only alumni/ae who granted permission to publish their names are shown. Questions regarding Great Dome Associates should be directed to Joseph P. Recchio at (617) 253-8213.

Verner C. Kreuter, Jr.
Francis X. Maida
Norman A. Matthews
Leon A. Menzl
Harry E. Metz
Gilbert C. Mott
Melvin A. Prohl
Harold E. Prouty
John C. Robbins, Jr.
Norman B. Robbins
Edward F. Tibbetts
Ralph P. Webster, Jr.
Albert E. Whitcomb
William C. Wold
Albert A. Woll
H. Arthur Zimmerman
Michael Zinchuk

1938
Franklin S. Atwater
Donald R. E. Barnaby
Merton S. Barrows
David W. Beman, Jr.
John H. Craig
Nathan Einis
Robert S. Gordon
Gifford Griffin
Harold James
Solomon Kaufman
John C. Kinnear, Jr.
Lester Kornblith, Jr.
H. Bruce Leslie
James Maguire
James P. Pollock
Frederick E. Ray
George B. Wood

1939
James W. Barton
George Beesley
Louis S. Castleman
Harold Chestnut
John H. Crankshaw
George D. Cremer
William K. Cutten
George Dadakis
David S. Frankel
Charles F. Freyfogle, Jr.
Frederick B. Grant
Walter A. Hargreaves
Michael V. Herasimchuk
John I. Herlihy
Benjamin T. Howes
Burkhardt A. Kleinhofner
B. Leonard Krause
Lawrence M. Lyons
L. Burns Magruder, Jr.
George P. Morrison
William A. Murphy
Irving Peskoe
W. Hewitt Phillips
Gordon A. Pope
Harold W. Pope
George G. Poulsen
Robert W. Pratt
Ryder Pratt
Burton D. Rudnick
Paul E. Sandorff
Frederick F. Schaller, Jr.
Samuel Sensiper
Julian M. Spencer
Alexander Squire
Robert A. Stone
Edwin M. Tatman
Wallace P. Warner
Irwin K. Weiss
William F. Wingard

1940
Alaettin M. Aksoy
James L. Baird
Scott Brodie
Harvey H. Brown
Roy W. Brown
John J. Casey
M. Arnold Copeland
Charles Forbes DeMallay
Richard P. Dickson
Margaret T. Dienes
N. Bruce Duffett
Richard J. Eberle
James E. Fifield

Morris I. Gabel
David R. Goodman
Harold Graham
Donald R. Harper
Edward G. Hellier
Amos E. Joel, Jr.
Joseph K. Knight
Frederick Lange
Frank H. Libman
Joseph F. Libsch
David F. Lowry
Richard E. MacPhaul
Marshall D. McCuen
Robert G. Miller
Schrade F. Radtke
Norman R. Scott
Philip A. Stoddard
Ralph N. Thompson
M. Spalding Toon
John A. Vanderpoel
L. D. Wheaton
George M. Wolfe

1941
William L. Babcock
Robert E. Bailey
Albert L. Bensusan
Robert Wallace Blake
Robert Wilson Blake, Jr.
Roger G. Blum
George B. Boettner
Albert H. Bowker
Joseph S. Bowman
George S. Burr
Charles S. Butt II
William T. Butt
Joseph E. Dietzgen
Martin L. Ernst
Robert M. Fano
Sanford E. Glick
Chester N. Hasert
Rudolph W. Hensel
Sterling H. Ivison, Jr.
William E. Lamar
Richard A. Lazarus
Zhi F. Li
Robert S. Lundberg
James W. Mar
Eugene A. March
Mitchell J. Marcus
Newell H. McCuen
Milton R. McGuire
Vaughan Morrill, Jr.
Willard S. Mott
Joseph H. Myers
Raymond G. O'Connell
Harold Radcliffe
John F. Sexton
Robert E. Smith
John J. Symons
Robert D. Taylor
Frederick H. Thompson

1942
Arthur W. Avent
Lawrence E. Beckley
Charles E. Bossi
Robert H. Crosby, Jr.

Luther Davis, Jr.
Philip E. Fox
Richard X. Gannon
Robert H. Given
Charles S. Hofmann
A. Paul Hotte
George M. Illich, Jr.
A. Carleton Jealous
Harvey Kram
Carthrae M. Laffoon
Bernard Levere
Warren S. Loud
Charles D. Magdsick
Adrian G. Marcuse
Claude M. McCord, Jr.
Carl L. McGinnis
David B. Nicholson
Milton M. Platt
L. Kenneth Rosett
William A. Rote
Robert N. Secord
John D. Stanitz
Morris A. Steinberg
Edward P. Todd

1943
Richard L. Ackerman, Jr.
George W. Bartlett
Arthur O. Black, Jr.
Frank E. Briber, Jr.
Frank A. Clauson
Paul R. Coulson
Thomas K. Dyer
David M. Falk
Howard S. Gleason
Steven Heller
Bedrich V. Hettich
Stewart M. Hill
James F. Hoey, Jr.
William H. Horton
James H. Johnson
Cyrus H. Kano
Charles J. Lawson, Jr.
Israel Z. Lenzner
Hung Liang
T. Kemp Maples
James O. McDonough
John M. Miller
Harry Ottinger, Jr.
Robert L. Rorschach
Stewart Rowe
Myron A. Shoffner
F. Curtis Smith
Morton F. Spears
D. Read Stevens, Jr.
Herbert G. Twaddle
William A. Verrochi
Michael Witunski

1944
Martin Annis
Robert E. Benedict
Richard S. Bettles, Jr.
Henry N. Bowes
John H. Burdakin
Robert M. Byrne
Herbert L. Carpenter, Jr.
John Chamberlain

Robert M. Copsey
Louis R. Demarkles
Bernard J. Duffy, Jr.
Lee C. Eagleton
John E. Egbert
John G. Floden
James M. Gassaway II
Norman L. Greenman
Holton E. Harris
James F. Hield
Richard H. Hinchcliff
Robert V. Horrigan
Robert H. Horsburgh
Warren H. Howard
John L. Hull
Austin T. Hunt, Jr.
Walter A. Jaeger
Martin King
Samuel H. Lamport
Jean-Claude Landau
Han Tang Liu
John W. Matthews
Edwin L. Moyer
Kenneth W. Nelson
Robert Oppenlander
Arthur F. Peterson, Jr.
E. Alfred Picardi
William S. Richardson
George S. Saulnier
Andrew J. Schmitz, Jr.
Eugene A. Schnell
Norman I. Sebell
Joseph Shrier
Leland F. Stanley
Robert V. Thiede
Page S. Ufford, Jr.
John Upton, Jr.
James Woodburn
Chester L. Woodworth
John Woolston

1945
John O. Atwood
James M. Barrabee
Walter E. Borden III
Alvin S. Cohen
Guy W. Gilleland, Jr.
Charles H. Hart III
Sing Leong
Robert N. Maglathlin
Andrew A. Marocchi
William G. Martin, Jr.
Thomas J. McNamara
William J. Meade, Jr.
Arthur E. Miller
Warren H. Miller
Nicholas V. S. Mumford, Jr.
David O. Richards
Eugene S. Rubin
Max E. Ruehrmund, Jr.
Luigi I. Russo
Malcolm L. Schoenberg
Robert K. Schumacher
Clinton H. Springer
Edward Stoltz, Jr.

1946
Lyal D. Asay

William E. Becker
Edward L. Belcher
Raymond E. Benenson
Lawrence G. Body
William F. Brace
Andrew B. Burns
William J. Casey III
Charles E. Cloud
Daniel I. Cooper
M. Louise Curley
Stanley T. Droski
James A. Finney, Jr.
Alexander E. Halberstadt, Jr.
Ernest G. Jaworski
Robert H. Marks
Gilbert Marr
John A. Maynard
Alexander W. McEwan
Harold Oakes
William H. Peake
James C. Ray
Martin L. Ray
Donald E. Robison
Nathaniel F. Rodman, Jr.
Arthur Schiff
Marvin Sparrow
Richard J. Steele
John W. Taylor, Jr.
Warren H. Turner
Louis B. Wadel

1947
Robert F. Athow
John E. Bartelt
S. Lewis Bernheim
Peter Callejas
D. Bart Carmody
Daniel J. Carnese
William J. Crawford III
Steffen F. Dieckmann
Walter R. Ericsson
Carl E. Eymann, Jr.
Hyman W. Fisher
David H. Frantz, Jr.
Wilfred L. Freyberger
Quentin D. Groves
Roy Haddox, Jr.
Theodore B. Hogg, Jr.
John G. Holmes
Charles W. Hoover, Jr.
Frederick H. Howell
Arnold S. Judson
Walter P. Kern
Edward C. Kistner, Jr.
Joseph U. Labov
Walter A. Lack
John Cephas Martin
Leslie C. Merrill
Laurent P. Michel
Gilbert S. Parker
R. Brooke Pietsch
James B. Prigoff
Gerhard Reethof
Richard A. Scheuing
Martin D. Schwartz
Irving L. Schwarz
Harry Sherman, Jr.

Bruce W. Stockbridge
Ferdinand S. Veith
David S. Yablom
Howard A. Zwemer

1948
Eugene Ashley
Fred C. Bailey
Marshall E. Baker
William Bangser, Jr.
Jack Baring
Richard V. Baum
S. Martin Billett
Carl Blake
Arthur W. Brusila
Kenneth C. Bushway
Thomas J. Cahill
Albert F. Carr
Cassius M. Clay
Richard J. Conlan, Jr.
George R. Cooper, Jr.
Robert Crane
Milton R. Daniels, Jr.
Robert C. Dean, Jr.
George S. Dundon
Arthur A. Fowle
Robert S. Friedman
Edward S. Frohling
Edward E. Gardner
Curtis S. Green
Alden F. Greenlaw
Peter A. Guercio
Elton F. Hammond, Jr.
John W. Hawkins
Edwin E. Hebb, Jr.
Frank J. Heger
E. Neil Helmers
John C. Henderson
Robert O. Hirsch
Frank J. Iskra
Jerome T. Jarrold
Frank A. Jones, Jr.
William J. Joyce
Benjamin F. Kendig
Harry L. Kopp
Louis F. Kreek, Jr.
Eric B. Kula
Philip M. Lally
Irwin L. Lebow
James Leon
George Lim
William A. Lockwood
Fred I. Magee
Franklin E. Mange
Bonni P. Martineau
Manuel L. Matnick
Erik L. Mollo-Christensen
John C. Moore
Robert R. Mott
Edward I. Newdale
John E. Nicholson
Harold Ottobri
Thomas E. Pawel
Gordon H. Pettengill
William R. Porter
John M. Randolph
Louis C. Rasmussen
Gilbert V. Rohleder
J. Norman Rossen
Jay S. Salz
William B. Schmidt
Norman Shillman
Arnold H. Smith
Earl K. Solenberg
Philip J. Solondz
Ellarson R. Stout
Donald F. Towse
John M. D. Walsh
Henry Warner
Hayden B. Willard
Backman Wong
G. Richard Worrell
Theodore R. Yoos, Jr.

1949
Hermann A. Allen
Angelo R. Arena
Marvin A. Asnes
Jack L. Baker
John W. Barriger IV
Orlien N. Becker

Paul S. Bercow
Robert O. Bigelow
William R. Bohlman
Frederick I. Brown, Jr.
Norman A. Chrisman, Jr.
James W. Christopher
Gary S. Colton
Stanley S. Davies
John Fairfield, Jr.
Guilford W. Forbes
Donald L. Gillespie
John W. Goppell
A. Neale Gordon
O. Summers Hagerman, Jr.
Frank B. Harris, Jr.
Charles K. Holmes, Jr.
Alfred F. Kenrick
Otto E. Kirchner, Jr.
John A. Knowlton, Jr.
Malcolm H. Kurth
Thomas J. Lamphier
Richard E. Lang
Ray E. Larson
William S. Lewis
Raymond A. Lindstedt
William J. Lueckel, Jr.
Robert F. Mahar
Blair L. Manning
Robert L. McConaughy
Ford F. Miskell
Richard D. Morel
Paul B. Ostergaard
Richard K. Pfler
Donald E. Ridgley
Lewis H. Roosa
John R. Saxe
Eugene B. Skolnikoff
Nathan O. Sokal
J. Thomas Toohy
Thomas Tsotsi
Vernon P. Turnburke, Jr.
Emilio J. Venegas
James Veras
Charles M. Walker
William F. Wicks
E. Zapata H.

1950
David D. Adams
Walter S. Attridge, Jr.
Peter B. Baker
George A. Basta, Jr.
Norton Belknap
Herbert D. Benington
Anne C. Bickford
John H. Bickford
Howard P. Bill
Donald R. Bresky
Sterling G. Brisbin
Richard C. Brogle
Thomas C. Buchanan III
Cosimo L. Cataldi
Edward S. Cohen
John W. Craig, Jr.
Thomas R. Eggert
A. John Esserian
James M. Fitzpatrick, Jr.
Harry G. Foden
James W. Geiser
Richard A. Gneco
Thomas N. K. Godfrey
Malcolm Green
Charles F. Grice
John A. Gutai, Jr.
Donald A. Harnsberger
Herbert L. Hochberg
Francis X. Hogan
James A. Hooper
Walter J. Kocher, Jr.
Robert A. Kovacs
Reginald A. Krystyniak
John S. Lane
John B. Lawson
Gerald A. Lessells
Stanley Martin, Jr.
John T. McKenna, Jr.
Edwin B. Miller
Raymond M. Moeller
William E. Mooz
William Murphy, Jr.
Will F. Nicholson, Jr.
Charles D. Nolan
Paul F. Pearce
Philip K. Pearson
Alfred M. Petrofsky
Robert L. Plouffe
Richard R. Potts
Richard P. Price
Harry F. Raab, Jr.
Milton L. Rand
Herbert A. Ridgway
Mariano A. Romaguera
Henry C. Sharp, Jr.
Thomas E. Shepherd, Jr.
John A. Smith
Karol A. Stark
Edward R. Stover
Constantine T. Tsitsera
Paul B. West
Robert E. Wilson

1951
Manfred E. Becker

Maria A. Bentel
John H. Bergmann
Christian C. Bolta
Edward L. Bronstien, Jr.
Frederick J. Bumpus
David J. Caplan
William J. Cavanaugh
John F. Dennis
George L. Downie
Charles W. Ellis III
Allan Elston
Frederick D. Ezekiel
Richard R. Fidler
David Findlay
Richard L. Foster
David A. Grossman
Thomas G. Hagan
Lawrence W. Hitchens
Charles R. Houska
Rodney G. Huppi
Hubert E. Knipmeyer
J. Franklin Koehler
L. Keith Koehler
George L. Larse
Frederick G. Lehmann
Robert A. Lindquist
Daniel E. Magnus
George H. Myers
Milton R. Neuman
Robert G. Norton
Charles A. Orne, Jr.
William D. Pinkham, Jr.
James A. Pitcock
Lester W. Preston, Jr.
John S. Prigge, Jr.
William G. Rhoads
Jay Rosenfield
Bernard Rothzeit
Laurence L. Rubin
Samuel Rubinovitz
George E. Schultz
Frederick Segal
Joseph N. Sherrill, Jr.
Harold Aryai Siegel
Howard E. Simmons, Jr.
Philip N. Simmons
Paul G. Smith
George R. St. Pierre, Jr.
Anthony Stathoplos
Richard Strauss
Richard M. Towill
Herbert B. Voelcker
Frederick W. Weitz
John J. Welch, Jr.
Bernard Widrow

1952
Arthur I. Auer
Clyde N. Baker, Jr.
C. William Carson
John C. Casson
Bock M. Chin
Robert H. Damon
Milton S. Dietz
Alan S. Geisler
Herbert Glantz
Nicholas J. Haritatos
Richard E. Heitman
Clifford H. Heslton
Oscar W. Kaalstad
Harry S. Kradjian
Arnold A. Kramer
Arnold G. Kramer
Richard F. Lacey
William H. Lane
Jack Larks
Michael D. Lubin
Daniel H. Lufkin
Robert M. Lurie
Richard E. Lyle
Alex S. Malaspina
Edward J. Margulies
Edward K. Matthews
Michael Nacey
Kevork V. Nahabedian
John B. Savoca
Clifford M. Sayre, Jr.
Stanley J. Solomon
H. Stephen Spacil
Shayne Stern
Thomas E. Stern
James R. Strawn
Arthur S. Turner
Emil J. Volcheck, Jr.
Seymour S. Weintraub
David W. Weiss

1953
Ralph D. Anglin
Joseph B. Banks
David M. Berg
Harris J. Bixler
E. Fred Brecher
John R. Ehrenfeld
Nicholas W. Fast
Thomas A. Faulhaber
Norman C. Ford, Jr.
Morton J. Friedenthal
Alan L. Friedman
Gilbert D. Gardner
Julian M. Greenebaum
Kent F. Hansen
Albert W. Hecht, Jr.

Yu-Chi Ho
Lionel L. Kinney
David L. Klepper
S. Eric Kondi
Nelson C. Lees
Richard L. Linde
George J. Meyer
Joseph F. Mullen
Herbert M. Oestreich
Robert R. Piper
Herbert H. Richardson
Burton M. Rothleder
Wilson H. Rownd
Stanley J. Sadowski
Paul P. Shepherd
Willard B. Spring
Maurice L. Torti, Jr.
James A. Zurbrigen

1954
Gordon Aitken
Robert E. Anslow
Barbara B. Black
John Blair
Wallace P. Boquist
Frederick H. Bowis
Michael B. Boylan
Jerome Catz
William H. Combs
Donald M. Dix
William J. Eccles
Camillo A. Ghiron
Philip Gilbert
John H. Gusmer
Arthur W. Haines
Dean L. Jacoby
Stephen J. Lirot
Samuel J. Losh
Louis E. Mahoney III
Kenneth S. Marks
Robert P. Mason
Richard G. McKee
William H. McTigue
Aristides Miliotis
Avrom A. Mintz
Raymond D. Mintz
Charles D. Palmer
Jerry L. Perry
William H. Ryer
Allen M. Schultz
George G. Schwenk
Oscar W. Sepp, Jr.
Marilyn L. Shilkoff
Charles M. Smith
David F. Springsteen
Harvey I. Steinberg
Robert W. Stewart, Jr.
James R. Stuart
George M. Thurlow
Jerome D. Wayne
David B. Whelpley
Klaus M. Zwilsky

1955
Paul H. Attridge
Richard I. Bergman
Robert F. Buntschuh
Edwin A. Chandross
Zaven A. Dadekian
Gilbert Davidson
William T. Deibel
Robert G. Dettmer
James H. Eacker
Philip N. Eisner
Eduardo L. Elizondo
Robert P. Greene
Michael E. Halpern
John F. Hayes
John T. Kennaday
Stephen B. Loring
Gerald P. Maloney
Sheldon H. Moll
Richard D. Nordlof
Frank E. Perkins
George Ploussios
Charles T. Prewitt
Karl A. A. Reuther
Charles S. Robertson, Jr.
Gregory L. Robillard
Randall S. Robinson
Walter Rubin
Walter G. Shifrin
W. Chandler Stevens, Jr.
John R. Stopfel
Allen G. Tarbox, Jr.
R. Peter Toohy

1956
George G. Alexandridis
Victor J. Bauer
Howard S. Bertain
Bruce B. Bredehoff
Arnold P. Bredeen
Paul E. Brown
John A. Buell, Jr.
Richard N. Carlson
Paul S. Cianci
Ronald C. Clark
Michael G. Damone
William R. Dickson
Irwin Dorros
Walter J. Farrell, Jr.
Arthur Frank

Stuart Frank
Walter P. Frey
Samuel S. Friedman
Larry R. Goldberg
James E. Hamblet
Richard L. Heimer
Robert J. Hochman
Charles P. Hoult
Charles C. Joyce, Jr.
David L. Kaufman
Robert L. Kissner
Thomas G. Kudzma
William M. Layson
Richard I. Mateles
Edward K. Moll
John D. Mueller
Joseph P. Neville
William E. Northfield
Wendyl A. Reis, Jr.
Axl E. Rosenblad
Harold H. Rothstein
Jesse Rothstein
Robert F. Santos
Robert N. Sawyer
Gottfried T. Schappert
Richard E. Skavdahl
Walter R. Sooy
Lindley S. Squires
Charles H. Stapper, Jr.
John D. Stelling
James O. Stenborg
Philip A. Trussell
Stuart Z. Uram
Sven A. Vaule, Jr.
John Hermann L. Walter
Joseph L. Wauters, Jr.
Stanley T. Wray, Jr.
Thomas Yonker
Francis H. Zenie

1957
Paul G. Adler
Paul R. Ammann
Richard L. Baird
Arthur E. Bergles
Bruce Blanchard
George H. Borrmann, Jr.
Alan S. Borstein
Richard D. Brandes
Howard I. Cohen
Bernard R. Cooper
Stewart M. Crawford
John B. Crews
John A. Currie
William H. Doughty
Ronald E. Enstrom
Lee H. Fister, Jr.
Milton Ginsburg
Boyd E. Givan
A. Dickson Hause
Herbert M. Heller
Robert J. Hull
Patrick B. Hutchings, Jr.
Frederick L. Jaggi
Joseph P. Kobus
W. Hugo Liepmann
Graham Lusk
Donald C. MacLellan
Terrence K. McMahon
Richard R. Monsen
Donald A. Norman
Eliot J. Pearlman
John P. Penhune
Silverster Pomponi
Ralph C. Reynolds
John J. Rinde
Robert H. Rosenbaum
Jared J. Safirstein
Herbert F. Schwartz
Richard D. Smallwood
Harold P. Smith, Jr.
Robert M. Sterrett II
Lavette C. Teague
William B. Thompson
Ralph J. Warburton
Stephen Weisskoff

1958
Roger D. Baggenstoss
James G. Barber
Edwin C. Bell
Sheldon W. Buck
Joseph T. Burval
Peter B. Carberry
Jack W. Christensen
Stephen Corman
Leslie C. Dirks
John F. Fallon, Jr.
Richard A. Finn
John B. Forrest, Jr.
O. Michael Gordon
Stephanos S. Hadjiyannis
William R. Hauke, Jr.
Alfred G. Hortmann
Richard H. Hough
John C. Ingraham
Alan T. Johnson
Robert D. Jones
McClaran Jordan
Kenneth H. Langley
Paul Z. Larson
King M. Lee

John H. Leigh
Hugh J. Murphy
John W. O'Brien, Jr.
Martin J. O'Donnell
Robert E. Oleksiak
Cornelius Peterson
Allen R. Philippe
David J. Rachofsky
Robert M. Rose
Paul H. Rothschild
Howard C. Salwen
George H. Schade, Jr.
Louis B. Seigle
Robert S. Slott
Steven R. Tannenbaum
Vigdor L. Teplitz
Roy F. Thorpe
Theodore J. Van Iderstine
Edward Wanger

1959
Hayward R. Alker, Jr.
Emile A. Battat
Larry C. Boyd
Gary L. Bracken
Robert E. Brooker, Jr.
James H. Brown
Edward W. Cheatham
Gilbert Y. Chin
Louis Cohen
George H. Connor, Jr.
H. Roberts Coward
Dwight B. Crane
George J. Elbaum
Norman A. Fujiyoshi
G. Neil Harper
George T. Haymaker, Jr.
Michael D. Intrinsic
Martin F. King
Alfredo G. F. Kniazzeff
Frank S. Koppelman
Kent Kress
Wilbur S. Latimer
William R. Malone
John K. Mitchell
Oscar L. Morgenstern
Donald E. Murray
David W. Packer
David F. Pawliger
Adul Pinsuvana
David A. Polak
Jerome P. Schooler
Joseph P. Seidel
Oliver E. Seikel
Stephen Spooner
J. Richard Swenson
Daniel I. Wang
Paul F. Weirauch
Jonathan B. Weisbuch
Stephen K. Whittemore
Marie M. Wray
James W. Ying
Martin E. Zimmerman

1960
Ronald D. Agronin
Jon Anthony Aldrich
Phillip B. Allen
Fred D. Arditti
N. Addison Ball
Paul F. Berg
Richard J. Bertman
Peter B. Brandt
Ronald M. Burde
E. Patrick Coady
John H. Connell
Robert P. De Marco
Richard L. De Neuville
Abe Feinberg
Charles J. Garbarini
Gary L. Gibson
Joseph I. Goldstein
Standley H. Goodwin
Robert N. Gurnitz
Kenneth E. Hagen
Stephen E. Halprin
Ulfr B. Heide
Joel Hirschel
Gerald H. Kaiz
Barry L. Karger
Dennis E. Kelly
Deena A. Koniver
Morris J. Kriger
Andrew Larsen, Jr.
Larry R. Martin
Edward O. McCartney
Richard L. McDowell
Kenneth R. Myers
William J. Nicholson
Richard H. Oeler
William M. Robertson
Howard L. Rosenthal
M. Elizabeth Schumacker
Susan E. Schur
William C. L. Shih
S. Christian Simonson III
Anton Simson
Richard F. Smith
Patrick S. Spangler
Carl V. Swanson
Robert S. Troth
Victor A. Utgoff
Leonard B. Vaughn

Joseph A. Verderber
Raymond G. Wilkins
Harold M. Woolf

1961
John W. Baxter
John S. Benjamin
Gary W. Bickel
John C. Blinn III
Mitchell B. Brodtkin
Alan H. Cohen
Ervin S. Davis
Joseph T. Davis
Robert J. Dulsky
Dorsey C. Dunn
Herbert A. Fox
Reed H. Freeman
Thomas L. Geers
Jerry I. Goldman
Peter R. Gray
William C. Grimmell
Gordon L. Guttrich
Ted J. Hammack
Grady W. Harris
G. Charter Harrison III
Thomas N. Hastings
Lawrence A. Horowitz
Richard S. Kaplan
Koo Sun Kim
John N. Kogan
Joseph A. Lestyk
Richard F. McKay
Richard A. Mezger
Robert S. Mroczkowski
Thomas P. Nosek
Michael J. O'Neill
Richard F. Otte
Leslie C. Patron
Richard J. Resch
David A. Roberts
Philip J. Robinson
Charles L. Ruttenberg
John C. Shambaugh
Mannie Smith
Barry M. Speyer
Nelson E. Stefany
Edward H. Strachan
Edward L. Tucker
Gayle L. Veber
Peter Ver Planck
John A. Vleck
Robert F. Weimer
Ronald D. Wendland
Raymond D. White
Samuel J. Williamson

1962
Robert E. Anderson
Lloyd Armstrong, Jr.
Grant A. Beske
William D. Bloebaum, Jr.
Richard A. Bronson
Peter Brown
W. Thomas Brydges III
Peter M. Canepa
Walter L. Colby III
Arthur R. Cooke
Donald M. Dible
George S. Dotson
James Stark Draper
James R. Dressler
Dean E. Eastman
Edward A. Feustel
Donald C. Fraser
Jonathan Gestetner
F. Keith Glick
William K. Goetz
Jeremy R. Goldberg
Theodore C. Goldsmith
Peter P. Goldstein
Gerald L. Gottlieb
Ben B. Gunter, Jr.
Rurik B. Halaby
Richard G. Helmg
Stephen R. Helpert
Aiyub A. Hoosenally
Richard L. Horrtor
Michael H. Kaericher
Joel A. Karp
Robert G. Kurkjian
Michael A. Lieberman
David R. Mayhew
James D. Miller
Richard J. Millman
Robert A. Morris
Robert F. Morse
Stuart A. Nelson
Cord W. Ohlenbusch
John T. M. Pryke
Joseph Rapaport
Darold W. Korabacher
Thomas S. Rowe
Earl R. Ruiter
Murray B. Sachs
Allen H. Saye
Elliot R. Schildkraut
Herbert L. Selesnick
Judith E. Selvidge
Peter R. Shrier
Stephen R. Smith
Oliver R. Smoot, Jr.
Norman P. Soloway
David S. Stare

Jeffrey I. Steinfeld
Gary M. Stuart
Roger J. Sullivan
Richard N. Sutton
John V. Terrey
Daniel E. Thornhill
Robert A. Wagner
George L. Wright, Jr.

1963

Paul D. Abramson, Jr.
Suhail A. J. Al Chalabi
Bruce Anderson
Michael H. Bender
Michael C. Bertin
Dean W. Boyd
Edwin F. Brush, Jr.
James A. Champy
Delmer L. Fehrs
Marshall S. Flam
John K. Flicker
Thomas A. Goddard
Richard P. Hervey
William A. Jessiman
Stuart Kurtz
John J. Lamberti, Jr.
Robert M. Levin
Norman W. Luttrell
Stephen W. Miller
Peter M. Mlynaryk
Ruth R. Nelson
Lawrence H. Pitts
Robert P. Porter
Russell E. Prins
Alan O. Ramo
Paul Richman
Daniel R. Ross
Ronald F. Rueckwald
Michael J. Schaffer
Joel E. Schindall
Martin H. Schrage
Charles C. Schumacher
Charles W. Selvidge
Stephen Swerling
James Y. Tang
Ronald A. Walter
Robert A. Warman
John H. Wasserlein
William J. Wolf, Jr.

1964

K. Andrew Achterkirchen
Julian R. Adams
Walter M. Anderson, Jr.
F. Michael Armstrong
Wayne F. B'ells
Alexis T. Bell
Gerald J. Burnett
Ernest M. Cohen
Ronald H. Cordover
Theodore J. Cruise
John P. Downie
Ronald D. Frashure
Keith D. Gilbert
Steven J. Glassman
Michael B. Godfrey
John N. Hanson
Lester L. Hendrickson
Robert H. Hobbs
David F. Hoover
Roger L. Hybels
Steven N. Iverson
Robert M. Johnston
Mark Joseph
Ashok S. Kalelkar
Joel S. Kalman
Stephen F. Kraysler
Fred L. Luconi
David F. Manchester
William B. McClure
Stephen B. Miller
William A. Nelson, Jr.
Robert L. Rothman
Fred W. Schaffert, Jr.
David Sheena
Andrew J. Silver
Jay M. Tenenbaum
William R. Young

1965

Arnold R. Abrams
John F. Beckmann
Edward A. Bucher
Edmund L. Burke
Pradip C. Burman
Arthur A. Bushkin
W. David Carrier III
Karl Chang
Calvin E. Cordulack
Charles W. Deane IV
Daniel S. Diamond
J. Stephen Duerr
Howard M. Ellis
Sidney J. Everett
Louis A. Frasco
William T. Freed
Peter G. Gerstberger
Frank P. Gerstle, Jr.
John J. Golden, Jr.
Robert B. Grady
Scott O. Graham
Joel C. Greenwald
George L. Hadley
Howard L. Helman

Edward P. Hoffer
John M. Holzer, Jr.
Michael D. Huke
Dawn F. Jacobs
John G. Kassakian
William N. Kavesh
Michael A. M. Keehner
Fred R. Kern, Jr.
David M. Kettner
Louis A. Kleiman
Peter R. Kornafel
Jesse B. Lipcon
George W. McKinney III
Walter L. Miller
Kayson Nyi
Piermaria Oddone
William H. Pike
Charles S. Rall
John D. C. Roach
Richard Roberts
Sharon Cutler Ross
Emile Sabga
Gregory L. Schaffer
Charles D. Senjowski
Peter Sexton
Donald L. Shulman
Richard S. Shultz, Jr.
Robert L. Silverstein
Douglas C. Spreng
Richard L. St. Peters
Alan R. Stottlemeyer
Edward K. Strauss
Bruce D. Sunstein
G. Wayne Thurman
Michael G. Weiss
Barry D. Wessler
Joel Westerman
Jarrod W. Wilcox
Stephen L. Williams
David L. Yuille

1966

Michael R. Adler
James H. Batchelder IV
Nazir A. Bhagat
Paul A. Branstad
William J. Briggs
W. Sumner Brown
William L. Bunce
George C. Byrd
William O. Cain
Thomas A. Casey, Jr.
Richard A. Clark
Peter M. Cukor
Ralph M. Davison
James C. Deckert
Steven H. Disman
James C. Edgerton
Charles E. Fallen
Victor K. Fung
Lewis H. Gaines
Byron Gilchrist
A. Mark Glickstein
Stanley A. Horowitz
Thomas H. Hutzelman
Robert R. Jackson
Kenneth J. Kepchar
Michael D. Kinkad
William J. Kosinar
Martin Krone
Michael R. Leavitt
Gerald B. Lichtenberger
David B. Liroff
Gerald F. Madea
Harry C. Moser
Michael D. Rinaldi
Ralph G. Schmitt
Mark S. Schwartz
Joseph I. Smullin
Wayne P. Stevens
Frank E. Surma, Jr.
John Torode
John H. Turner, Jr.
Ronald W. Ward
H. Allen White III
Robert S. Zucker

1967

John Acevedo
Donald A. Belfer
Victor M. Bermudez, Jr.
William M. Bloomquist
Donald J. Bosack
James W. Carter
William L. Caton III
John W. Cook
John M. Davis
David A. Dilling
M. William Dix, Jr.
Kenneth G. Follansbee
Barbara A. Gilchrist
Harvey Golomb
Lawrence C. Hall
Alan B. Hayes
Edson C. Hendricks
Robert C. Hewitt
Alan R. Hirsch
Charles E. Kolb, Jr.
Alan E. Kruse
Arthur C. Kwok
Eric K. Li
Douglas L. McCraith
Susumu Mitarai

Charles V. Moran
Donald R. Oestreicher
John S. Podolsky
John C. H. Reykjalinn
George S. Sacerdote
Chester L. Sandberg, Jr.
Marc G. Schulman
Andrew D. Skibo
Melvin Snyder
Karsten Sorensen
Jeffrey P. Stamen
James A. Swanson
Robert C. Todd
Gerald L. Tomanek, Jr.
James C. Tsang
Eugene L. Venturini
Glenn A. Wanek
Jeffrey M. Wiesen

1968

Harvey Allen
Platte T. Amstutz III
Robert B. Anthonyson
Richard E. Boyatzis
Marilyn M. Bruneau
William E. Carlson
Samuel A. Cohen
Arthur E. Cole, Jr.
Fredda H. Cole
Nicholas J. Covatta, Jr.
Shan Cretin
David J. Dimlich
Julian P. Freret, Jr.
Claude L. Gerstle
Paul A. Gluck
George M. Goldmark
Daniel M. Green
Peter Groot
Daniel G. Gruber
Robert C. Hendel
James C. Hsia
Karl H. Karash
Paul C. Kimball
Tim Kjellberg
A. James Laurino
Jonathan M. Lehr
Robert Y. Li
John P. Linderman
Michael J. Marcus
Scott P. Marks, Jr.
Robin K. McGuire
Scott J. Mermel
G. Allen Merry
Juan M. Meyer
Charles B. Miller, Jr.
Jesper Munch
William M. Parks
Darryl Pomier
Hughes Pope
Richard E. Reese
David J. Roberts
Joel P. Robinson
Ronald S. Rosen
Jack A. Russell
Leonard H. Schrank
Jonathan D. Shane
Barton W. Stuck
Michael G. Tashker
Armen Varteressian
Randall Warniers
William G. Zink

1969

Burt S. Barnow
William P. Bengen
James H. Black, Jr.
Mark L. Braunstein
Paul D. Brophy
David A. Cane
Marc Davis
Lee A. Dilley
Gary C. Dixon
Robert H. Dobson
Bruce R. Donath
Mark Dracken
David B. Erickson
Matthew M. Franckiewicz, J.
Anthony George
Jeffrey H. Grotte
Bruce K. Hamilton
Robert J. Harrington
Bruce L. Heflinger
Joseph A. Horton
Kenneth R. Hules
John F. Kaar
David P. Kelleher
Thomas H. Kick
Bernard E. Klein
Aaron Kleiner
Alan M. Kudler
Carl W. Kuhn, Jr.
Michael W. Laird
Stanley B. Limpert
Mark B. Lively
John I. Loewenstein
Robert G. McGregor
Dean S. Musgrave
Roy F. Quick, Jr.
Robert J. Randall
William Lee Roberts
Christopher R. Ryan
Joel I. Seiferas
William T. Stewart
Kathryn A. Street

Michael A. Talalay
Michael P. Timko
James P. Truitt, Jr.
Hal R. Varian
Eben T. Walker
Jeffrey M. Weissman
Smith T. Wood
Robert R. Zimmerman

1970

Richard A. Anderson
Fred Andree
Gregory K. Arenson
Karen H. Arenson
O. Reid Asher, Jr.
David S. Bann
Douglas F. Bender
Wendell C. Brase
James C. Bronfenbrenner
Paul Burstin
James L. Caldwell
Eric K. Clemmons
Stephen F. Cooper
David P. Dobkin
Ireneed du Pont III
John C. Eichelberger
James Fong
James S. Gaetjens
Carol A. Goldstein
Geoffrey R. Handler
John C. Head III
Michael W. Hurst
Sydney V. Jackson
Robert L. Jeffcoat
David Koh
Steven A. Kruger
Charles Lieberman
Paul Manoojian
James M. McCarthy
William C. Michels
Robert C. Morse
William B. Parsons
James M. Patell
David T. Patten
Norman C. Payson
Anthony C. Picardi
Wayne R. Porter
David M. Rapoport
Christopher L. Reedy
Dean H. Roller
Robert F. Rorschach
Richard L. Rosen
James B. Rothnie, Jr.
M. Kimberly Rupert
Sandra A. Skiba
Herbert F. Stevens, Jr.
Stephen R. Takeuchi
David W. Thiel
Harold M. Ting
Harold M. Wilensky

1971

Richard A. Aparo
Kenneth A. Bauer
Joseph K. Boddiford, Jr.
Glen A. Brunk
Alfred S. Callahan III
R. A. Castro Alpizar
James R. Coke
Donald S. Feith
Randolph G. Hawthorne
Tim B. Holiner
Martin L. Jack
Janet A. Koch
David L. Lapidus
Robert E. Lindgren
Timothy J. Maloney
Robert D. Marshall, Jr.
Robert E. Miegel
Laurence Peters
Richard L. Plambeck
Gary N. Pullar
Jan K. Smeets
Alfred M. Solish
John A. Stefan
Patrick B. Sullivan
Edward J. Vaver
Joseph B. Walters, Jr.
Charles W. Werner
Richard H. M. Willoughby
R. Dale Zellers

1972

Paul W. Andrus
Joseph A. Auer, Jr.
Raymond L. Azzi
Lawrence S. Bawco
Bradley C. Billietaux
John M. Bissell
Josie C. Breedon
Kenneth M. Brown
Jack E. Cater
Terrill J. Chang
Stephen A. Chessin
Leonidas P. Colakis
Alan Michael Cooper
Don Coppersmith
Wilhelm Daida
David A. Davis
Rebecca A. Donnellan
Cyril W. Draffin, Jr.
Bradford A. Dulmaine
Thomas W. Eagar

Preston R. Ford
Bernard Gitler
Marshall B. Goldman
Robert S. Goodof
James J. Gurley
Robert S. Hart
Michael L. Harvey
Patrick M. Heilman
James N. Heller
Hans W. Khimm
John E. Krzywicki
Janet S. Lantner
Conor D. Reilly
Lawrence D. Rosenthal
Michael J. Rowny
James W. Roxdo
Lynn M. Roylance
Hikaru P. Shimura
Leonard H. Sigal
Robert A. Stein
S. Gail Thurmond
Carl H. Whittaker
Albert S. Yee

1973

Paul C. Ahrens
Bertrand C. Barrois
Jay F. Benesch
John R. Bertschy
Roger P. Bowers
Frans Christ
Rodney B. Corlin
Mary J. Crooks
William D. Dannelly
Robert G. Eccles, Jr.
Thomas E. Ellis
John R. Gersh
Mark S. Glasser
Paul A. Green II
Nicholas T. Hamisevicz
Elaine Kant
Mitch Kaplan
Lisa C. Klein
B. John Lange III
David Lee
Patrick A. Marcotte
Robert L. Miller, Jr.
Gregory E. Moore
Douglas B. Moran
Mark Carroll Oakes
C. Timothy Ryan
Philip M. Sadler
William R. Short
Thomas R. Stagliano
Paul A. Swartz
Dennis Tully
James S. Wiley III

1974

James Richard Andrew
Edwin M. Arripp
Bruce Wayne Barker
Frank J. Commons
Dee A. Crouch
E. Martin Davidoff
Piero Daniel Di Capua
Michael Peter Filosa
Ian Fisher
Daniel Dustin Foley
Lionel J. Goulet III
Richard Alan Hartman
Rodney C. Hartman
Michael James Hassett
Charles Edward Hillman
John Widtman Hurd
Michiro Iwanaga
Thomas E. Knight
Manuel A. Malagon-Fajal
John B. Miller
Gary H. Miyashiro
Barry Nathan Nelson
John Emery Plum
Gary David Raymond
J. Alan Ritter
Leonard E. Roberts, Jr.
Frank M. Sauk
Laurence John Segil
Marko M. G. Slusarczuk
Rinaldo A. Spinella
W. Wayne Stargardt
Richard J. Sternberg
R. Gregory Turner
Jay W. Van Dwingelen
Douglas W. White
Richard E. Zippel
Dirk Adrian Zwemer

1975

Kenneth J. Armstead
Mark D. Beasman
Peter P. Blanshan
Jeffrey M. Broughton
Patricia R. Callahan
Martin R. Cawthon
John Dana Chisholm
Loren E. Dessonville
Moray P. Dewhurst
Charles J. Digate
Michael R. Dornbrook
M. Bruce Fegley, Jr.
Charles Fendrock
Frank P. Fezzie, Jr.
Michael A. Gipe
Ilene S. Gordon

Paul D. Husby
Donald W. Inadomi
B. Anthony Isaac
Frank Klotz
Michael G. Kozinetz II
Alan E. Levin
Karl I. Li
Christine R. P. Lofgren
Mark A. Lysne
Robert W. Mann, Jr.
Richard J. McCarthy
Thomas F. McKim
James A. Moody
Barbara L. Moore
Bernard H. Robinson
F. Patrick Schultz
Gregory L. Shaw
Donald E. Shobrys
Algirdas J. Skriniska
Steven L. Sneddon
John Stiehler
John D. Sybalsky
Arlo F. Weltge

1976

Janis Bestul Ossmann
Leslie R. Chermak
Andrew S. Farber
Richard L. Farber
Wayne S. Hamburger
John J. Hanzel
Jeffrey J. Held
Neil E. Kaden
Mark E. J. Keough
James W. Lambert
David L. Lee
Reynold Hans Lewke
Eric H. Michelman
Susan A. Riedel
Linda Q. Sax
John D. Schoedel, Jr.
Lee M. Silberman
Eric R. Steinhauer
James P. Wajda
Gail M. Walker

1977

Paul J. Ackman
Charles B. Baltimore
William Baum
Alec S. Berman
David R. Bieberle
Richard W. Buck
Earl H. Bunker
Craig W. Christensen
David A. Dobos
Leonard N. Evenchik
Thomas B. Fetter
Thomas C. Gooch
Walter H. Goodwin
Michael J. Haney
Stephen W. Keith
Alexander Ling
Kevin B. Miller
Thomas C. Mills
Charles G. Mogged, Jr.
Timothy F. Monson
Daniel A. Nole
Virginia P. Potter
W. M. Kim Roddis
Robert M. Russ, Jr.
Steven H. Spiro
Leigh E. Watlington

1978

Bradley S. Albom
Howard S. Baron, Jr.
Richard H. Brudnick
David B. Burstein
James J. Heeger
Thomas C. Janson
Susan L. Kayton
Thomas F. Knight, Jr.
Donald B. Mellen
Francis E. Murphy III
Teresa C. Nolet
George M. Orlov
Barbara K. Ostrom
Robert G. Resnick
Howard Shao
Eric R. Shienbrood
John E. Swindle
Steven C. Webster
Arthur Wright

1979

Richard C. Berry
Keith L. Dimonier
Randall E. Fahey
John J. Fraticchio, Jr.
Norman R. Guivens, Jr.
Andy Hegedus
Paul E. Hoffman
David A. Holt
Donald Jue
Robert S. Klein
Ellen Leckband
Gerald T. Michael
Barry A. Newman
Louis J. Paglia
Brenda Pomerance
John F. Pries
Larry S. Rosenstein
Charles B. Roxlo
Jeffrey J. Russell

1980

Jeffrey H. Berman
Thomas A. Curtis
Jeffrey M. Jaycox
Barbara M. Johnston
Timothy J. McManus
Scott A. Norton
Kenneth D. Oya
Brian J. Picht
Howard W. Seidler

1981

Jeffrey J. Anderson
Warren J. Dew
George M. Dowd
Ellen C. C. Fischer
A. David Himle
Roger A. Ishimoto
Glenn L. Katz
Charles I. McCauley
William I. Ogilvie
David L. Pincney
Christopher S. Wheeler

1982

Thomas J. Calderwood
Douglas M. Chin
Charles Frankel
Fred W. Helenius
Alison B. Kutchins
Matthew Prete
Philip B. Romanik
David B. Teller

1983

Elizabeth Bradley
Paul S. Cunningham
John E. De Rubes
Raymond E. Goldstein
Lawrence J. Kaufman
Barry Margolin
John E. Mraček
David V. Payne
Rhonda J. Shaw
James E. Thomas, Jr.

1984

Russell L. Brand
Mark A. Robien
Mitchell A. Rosenberg
Lock See Yu

1985

Maureen A. Sybertz
Abel S. Tong

1986

Robert E. Malecki

Advanced Engineering Studies

Harold H. Leach '70

Aeronautics & Astronautics

William B. Abbott III '61
Karl H. Bergey, Jr. '51
Eugene E. Covert '58
Carlo N. De Gennaro '53
David W. Dove '71
John T. Harduvel '72
Thomas J. Harriman '43
Gerd Hengsbach '74
E. Eugene Larrabee '48
John W. Leech '57
Richard D. Linnell '48
John A. Long '33
G. MacCartney '53
Howard A. Magrath '38
James S. McDonnell III '59
Theodore H. H. Pian '48
John G. Ryan '60
George S. Schairer '35
Leroy P. Smith '49
Robert R. Sparacino '61
Robert Lee Townsend '43
A. Tobey Yu '46
Joseph E. Zupanick '50

Architecture

Sarah K. Abrams '85
Takashi Anoka '86
Leon E. Bailey '58
John Manning Baldwin '74
Gerald I. Brecher '86
Victor Caliendo '68
C. Rosalie C. Carson '47
Robert P. Cooke '62
Charles F. Davis III '66
Thomas G. DiGiovanni '85
Alan B. Dolmstadt '68
Gerald E. Ervin '59
G. Kent Gonzales '85
Toufic E. Kadri '82
Ernest E. Kirwan '59
Don Klabin '85
John W. McCormack '85
Terence S. Meehan '83
Marian Moffett '75
Charles D. Nolan, Jr. '86
Ki Suh Park '49
John W. Peirce '47
Elliot Saltzman '51
John I. Schlossman '56
Margot Lyman Sprague '85
Norris Strawbridge '76
Peter G. A. van Dijk '56
Ellen A. Watts '85
Ewart A. Wetherill '58

Paula Gonsalves Williams '85

Chemical Engineering

Donald B. Anthony '74
Michel L. Besson '60
Rowland S. Bevans '46
P. L. Thibaut Brian '56
James S. Bruce '39
Michael C. Chen '73
John P. Cogan '32
Bradley Deway, Jr. '40
Ini A. Ekpenyong '82
Cherry L. Emerson '41
Joseph S. Finger '41
Howard Grekel '47
Gary R. Hattery '78
William R. Hawthorne '39
Allen F. Horn '84
Chi-Wen Hung '79
George R. Jasny '52
James R. Katzer '70
Robert W. Koucky '56
William C. Krumrei '51
James Lago '47
Yi Hua Ma '67
Michael P. Manning '76
Geoffrey Margolis '69
Charles P. Marion '52
C. Toby Marion '71
Edward A. Mason '50
Guy T. McBride, Jr. '48
Terence C. McDonald '84
Edward W. Merrill '47
Timothy Lee Montgomery '74
Albert L. Moore '58
William M. Murray, Jr. '55
James P. Noyes '53
John H. O'Neill, Jr. '51
Carl S. Oldach '41
Ralph R. Paxton '49
Donald W. Peaceman '51
Frank G. Pearce '46
F. Phillips Pike '36
H. Maxwell Quackenbos '41
John Z. Raymond '62
William A. Reed '43
Robert L. Richards, Jr. '51
Robert J. Richardson '54
Irvn H. Rinard '57
Murray W. Rosenthal '53
George F. Schlaudecker '39
John P. Schmidt '63
Hugh W. Schwarz '42
Yen Shen '42
Robert E. Siegfried '47
Frank W. Smith, Jr. '49
Yih-Hong Song '78
Benno Stork-Wersborg '72
Tzeng J. Suen '35
Jefferson W. Tester '71
Robert S. Timmins '57
Charles K. Walker '40
Douglass J. Warner '59
Byron B. Woertz '39
Patrick S. L. Wong '62
W. Kelly Woods '36
William W. Yuan '59

Earth, Atmospheric & Planetary Sciences

Norman M. Brenner '75
David Greenewalt '60

Economics

Marcelle V. Arak '67
George B. Baldwin '52
Leslie Cookenboo '53
William Dellal '77
Harold E. Dreyer '52
Ann F. Friedlander '64
Vincent A. Fulmer '53
Thomas G. Hall, Jr. '52
James W. Hanson '52
William W. Keefer '50
Philip Kotler '56
William F. Massy '60
J. Wade Miller, Jr. '48
Scott E. Pardee '62
Nicholas S. Perna '69
Charles J. Stokes '51
Paul N. Van de Water '75
Philip K. Verleger, Jr. '71

Electrical Engineering & Computer Science

Richard C. Booton, Jr. '52
Emmett H. Bradley '50
Wesley G. Brodsky '74
Julian J. Bussgang '51
Fred B. Cox, Jr. '58
John R. Cummings '57
Anthony P. Di Vincenzo '47
Michael D. S. Donovan '64
Jay W. Forrester '45
Paul J. Fox '73
Hans P. Geering '71
Kenneth W. Goff '52
Yehuda Golahny '54
Frederick L. Hafer '50
David L. Isaman '79
Robert M. Johnson '56
Alexander Kusko '44
Robert W. Lawler '79
Gordon M. Lee '44
Jane W. S. Liu '68
Edward F. Magnusson '48
Terrence P. McGarty, Jr. '71
Charles W. McRimmon III '55
C. E. Miller '66
Edgar A. Miller '67
Stephen D. Moxley, Jr. '50
John R. Mulhern '70
Eni G. Njoku '76
Louis L. Odette '81
Steen A. Paul '75
Stewart D. Personick '70
Alexander L. Pugh III '53
James R. Relyea '58
Joseph P. Rymer '80
Adel A. M. Saleh '70
William M. Snyder, Jr. '39
Robert J. Spinrad '63
James L. Walker '67
Gifford E. White '41
David A. Wright '67

Life Sciences

Forrest Foor '73
Thomas A. Jordan '75
Edward S. Josephson '40
Trent S. Russell '42
Cecily C. Selby '50
Jacob Struck, Jr. '58
Lydia Villa-Komaroff '75
Alfred M. Webb '47
Dyann F. Wirth '78
Helen H. Wong '75

Civil Engineering

Thomas W. Anderson '37
Albert H. Bryan, Jr. '48
Francis Y. H. Chin '73
Kenneth C. Deemer '52
William S. Dunbar '79

Terence M. Garvey '56

John K. Gohagan, Jr. '73
Donald R. F. Harleman '50
Brendan M. Harley '71
Kathryn June Hatcher '74
Olimpia M. Hernandez Pena '84
John F. Kennedy '76
Frank S. Koppelman '59
Thomas D. Landale '54
Robert F. Lathlean '46
Shih Y. Lee '43
William O. Lynch '47
Salvador Miranda Barreda '82
Harley L. Moore III '73
William A. Moylan '80
Tavit O. Najarian '75
Donald R. Pennell '62
Asaf A. Qazilbash '65
Thomas J. Regan, Jr. '68
Arthur C. Ruge '33
De Vere W. Kyckman '56
Neil S. Shifrin '80
Sam B. Starobin '54
John C. Stewart '80
M. Llewellyn Thatcher '72
George P. Turci '56
Polyvios C. Vintiades '61
Brian J. Watt '70
Stanley M. White '76
Robert L. Wilcox '55
Michel H. Zaleski '71

Earth, Atmospheric & Planetary Sciences

Norman M. Brenner '75
David Greenewalt '60

Economics

Marcelle V. Arak '67
George B. Baldwin '52
Leslie Cookenboo '53
William Dellal '77
Harold E. Dreyer '52
Ann F. Friedlander '64
Vincent A. Fulmer '53
Thomas G. Hall, Jr. '52
James W. Hanson '52
William W. Keefer '50
Philip Kotler '56
William F. Massy '60
J. Wade Miller, Jr. '48
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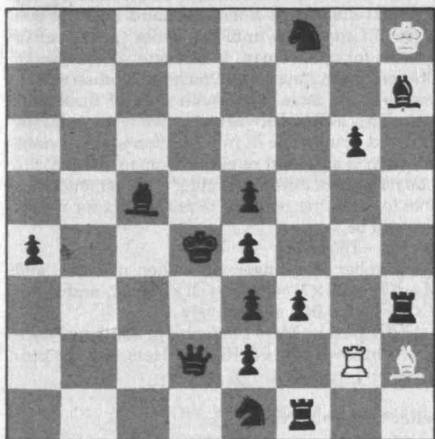
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Mnage Solved. Now Try the Towers of Hanoi

It has been at least a year since I specified the size of the backlogs for all the various kinds of problems that are printed. Let me do so now. I have close to a year's supply of regular, chess, and speed problems; computer and bridge problems are in short supply.

I would like to thank all those readers who sent season's greetings (this is the first column I am writing in 1988) to my family and me. Alice, David, Michael, and I wish you all a healthy and happy new year.

APR 1. We begin with a helpmate problem from *The Tech*, M.I.T.'s student newspaper. Black moves first, and White and Black are to cooperate so that Black is mated on White's fourth move.



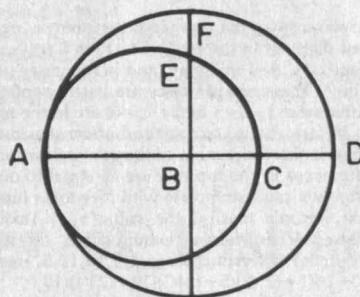
APR 2. John Rule wants you to find two positive integers differing by five such that the sum of their squares is a perfect cube, and to show that the solution is unique.

APR 3. Peter Gottlieb (no relation) has an interesting variation on the famous Towers of Hanoi problem:

As with the standard version, there are three pegs; initially there are n rings on one of the pegs, graded in size from largest at the bottom to smallest on top. The problem is to find the minimum number

of moves to transfer all of the rings to another peg, one at a time, never having a larger ring on top of a smaller one. The variation is that only clockwise moves are permitted. For example, if the pegs are labeled A, B, C, then the only moves permitted are A to B, B to C, and C to A. There are two cases of solution, one for moving all the rings to the nearest peg in the clockwise direction, and one for moving to the third peg.

APR 4. Here is one Jim Landau found in the *Washington Post* classified ads: The two circles shown in the diagram below touch at A. The larger circle has its center at B. The width of the crescent between points C and D is 90 mm. and between points E and F the distance is 50 mm. What are the diameters of the two circles?



APR 5. Ronald Martin has a magic square problem for us:

Arrange the integers from 1 to 25 in a 5×5 grid so that each column and row sums to 65. Moreover, each of the 10 diagonals is to sum to 65. These 10 diagonals are formed by starting at each of the 5 elements in the first row and proceeding southwest and southeast, identifying the left and right edges of the grid. For example, one diagonal includes the elements located at (1,4), (2,3), (3,2), (4,1), (5,5).

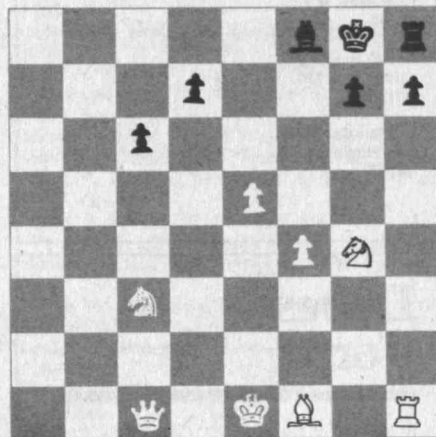
Speed Department

SD 1. Jim Landau wants to know: What is the rarest play in chess?

SD 2. Charles Piper has a glass of wine and a glass of water. He takes a teaspoon of the wine and stirs it into the water and then takes a teaspoon of the result and puts it back into the wine. Is there more water in the wine or more wine in the water?

Solutions

DEC 1. White is to move and mate in two.



C. Larson found the following solution:

1. B-c4 ch P-d5
2. P×P e.p. mate

Matthew Fountain notes that *Chess Life* reported that a similar theme has been used in a TV spy movie and in its Russian remake.

Also solved by David Simen, Steven Feldman, Karim Roshd, Brian Lebowitz, Steven Gordon, Dennis White, Scott Berkenblit, Richard Hess, Kenneth Bernstein, Ron Raines, John Cronin, Avi Ornstein, Elliott Roberts, Abraham Fineman, Turner Gilman, Mark Haberman, Michael Jung, Paul Herkart, Allan Orloff, Tomo Hasegawa, and the proposer.

DEC 2. Determine, without using a computer or calculator, which is larger, e^π or π^e .

The following solution is from R.P. Boas: Here is the shortest proof I know that $\pi^e < e^\pi$: For $x > e$, $x/\ln x$ increases (its derivative is positive), so $x/\ln x < y/\ln y$ if $y > x \geq e$. $x \ln y < y \ln x$ $e \ln \pi < \pi \ln e$ $\pi^e < e^\pi$.

Also solved by Kenneth Bernstein, Jim Landau, David Wagner, Winslow Hartford, Richard Hess, Scott Berkenblit, Dennis White, Steven Gordon, Brian Lebowitz, Karim Roshd, David Simen, Robert Cesari, Alan Taylor, Harry Zarembo, Bill Cain, Edward Dawson, John Moore, Christopher Grayce, Ken Haruta, Mary Lindenberg, John Prussing, Benjamin Wurzbarger, Ken Rosato, Timothy Maloney, Frank Quinn, and Matthew Fountain.

DEC 3. Show that there are no positive integer solutions to: $X^3 + Y^3 + 4 = Z^3$.

The following solution is from Edward Dawson: The cube of any integer is given by one of the following functions of an arbitrary integer N: $(9N + 4)^3 = 9(81N^3 + 108N^2 + 48N + 7) + 1$ $(9N + 3)^3 = 9(81N^3 + 81N^2 + 27N + 3)$ $(9N + 2)^3 = 9(81N^3 + 54N^2 + 12N + 1) - 1$ $(9N + 1)^3 = 9(81N^3 + 27N^2 + 3N) + 1$ $(9N)^3 = 9(81N^3)$ $(9N - 1)^3 = 9(81N^3 - 27N^2 + 3N) - 1$ $(9N - 2)^3 = 9(81N^3 - 54N^2 + 12N - 1) + 1$ $(9N - 3)^3 = 9(81N^3 - 81N^2 + 27N - 3)$ $(9N - 4)^3 = 9(81N^3 - 108N^2 + 48N - 7) - 1$



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012.

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These equations show that no cube of an integer differs by more than 1 from an integral multiple of 9. So when the sum of any two cubes of integers is subtracted from the cube of a third integer, the result cannot differ by more than 3 from an integral multiple of 9. Therefore no solution in positive integers is possible for either of the equations $X^3 + Y^3 + 4 = Z^3$ and $X^3 + Y^3 + 5 = Z^3$.

Also solved by Steven Gordon, Scott Berkenblit, Richard Hess, Winslow Hartford, David Waggoner, Jim Landau, and Kenneth Bernstein.

DEC 4. What is the probability that six random numbers chosen (without replacement) from 1 to 36 will have at least one adjacent pair (like 12 and 13, for example).

The following solution is from Matthew Fountain: The probability for at least one adjacent pair is 0.621992. We begin with our solution by constructing an array in which a_{ij} is the number of ways j integers can be assigned positive integer values equal to or less than i , with no two values adjacent or equal. $a_{ij} = 0$ when $i < 2j - 1$, as j integers not adjacent to each other require a range of at least $2j - 1$. $a_{i,1} = i$, as in this case the one integer may assume any value from 1 to i . When $j > 1$, $a_{ij} = a_{i-1,j} + a_{i-2,j-1}$. This is true because $a_{i-1,j}$ is the number of ways the j integers fit in the range 1 to $i - 1$ without being adjacent and $a_{i-2,j-1}$ is the number of ways j integers fit in the range 1 to i when one integer equals i . Fortunately, only a small part of the array needs to be constructed. The following is more than enough.

1	2	3	4	5	6	7	8	9	10	11	12
	0	1	3	6	10	15					
		0	1	4	10	20					
			0	1	5	15					
				0	1	6	21				
					0	1	7				

The bottom row of the array indicates that six non-adjacent digits fit in the range 1 to 10 in 0 ways, in the range of 1 to 11 in 1 way, and in the range of 1 to 12 in 7. These simple cases are easily verified. The differences $1 - 0 = 1$ and $7 - 1 = 6$ are in the row above. In fact, due to our method of construction, each row is the differences of the row below, and the differences in the top row are all equal to one. Therefore we can extrapolate with Newton's interpolation formula to find the value $a_{36,6}$. Taking $a_{10,6} = 0$ as the base for our extrapolation, the successive-order differences are 1, 5, 10, 10, 5, 1 and $a_{36,6} = 0 + 26(1 + (25/2)(5 + (24/3)(10 + (23/4)(10 +$

$(22/5)(5 + 21/6))) = 736281$.

The number of ways taking 6 values from 36 is $36!/(6!30!) = 1947792$. The probability of at least one adjacent pair is $1 - 736281/1947792 = 0.621992$. The differences 1, 5, 10, 10, 5, 1 are the binomial coefficients of $(1 + a)^5$. Inspection of the array reveals that the values in third, fourth, and fifth rows can similarly be extrapolated using differences that are binomial coefficients. A general formula for any a_{ij} could be derived from this observation.

Several readers used computer searches to arrive at their solutions. Robert Moeser makes the observation that he first wrote a straightforward brute-force program and then derived a clever version that avoided much of the searching. However, this latter program ran slower! His conclusion: "So much for cleverness."

Also solved by Kenneth Bernstein, Steven Gordon, Winslow Hartford, Mary Lindenberg, David Simen, Harry Zaremba, Dennis White, Steven Feldman, Richard Hess, Simson Garfinkel, and Scott Berkenblit.

DEC 5. Solve the Mnage problem, where you have a certain number of couples to dinner and you wish to seat them at a round table, with men and women alternating and all the couples separated. How many different arrangements are possible for three couples? For four? For ten?

The following solution is from Harry Zaremba: To generalize, assume there are n couples invited to a dinner, and that the position of one woman at the table is considered fixed as a reference point. In alternate locations from the fixed point there will be $(n - 1)$ chairs available to the same number of women. The first alternate chair clockwise from the fixed position can be selected by any one of $(n - 1)$ different women, the second alternate chair by one of $(n - 2)$ different women, the third chair by one of $(n - 3)$, and so on until the last or $(n - 1)$ st chair remains for one woman. In all there will be $(n - 1)!$ different permutations in which the women can be seated at the table. Now with each of these permutations, a chair between any two women can be occupied by any one of $(n - 2)$ different men, none of whom is an escort of either woman. Hence, the total number of different seating arrangements possible to fulfill the problem requirements for n couples will be,

$$P_n = (n - 1)!(n - 2).$$

The number of arrangements when $n = 3, 4$, and 10 are $P_3 = 2! \times 1 = 2$, $P_4 = 3! \times 2 = 12$, and $P_{10} = 9! \times 8 = 2,903,040$, respectively.

Also solved by Mary Lindenberg, Matthew Fountain, Winslow Hartford, Richard Hess, and the proposer.

Better Late Than Never

JUL 2. Edward Dawson notes two misprints in the published version of his solution. The vertex at the lower left should have three coordinates, the second of which is $-\sqrt{3}u/2$ and in the text Y-coordinates have numerators of $\sqrt{3}u$ instead of $\sqrt{3}u$.

JUL 3. Michael Jung and Turner Gilman note that the span between 15:55:51 and 20:00:02 is 4:04:11.

JUL 5. Michael Jung points out that there are actually three triangles in the drawing. Moreover, the shaded region has area $\theta - .5\sin\theta\cos\theta$.

OCT 3. Avi Ornstein and John Cronin have responded.

OCT 4. Raymond Gaillard has responded.

OCT 5. Benjamin Wurzbarger has responded.

Proposers' Solutions to Speed Problems

SD 1. Underpromotion to a bishop or rook. The only plausible reason for such underpromotion is to prevent a stalemate, as illustrated in problem 1984 F/M 1.

SD 2. Neither. They are the same.

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Kenneth Eldredge, Sr., '16; March 26, 1987; Canton, Conn.
Winthrop C. Swain, '17; June 1, 1987; Hingham, Mass.
Paul G. Woodward, '17; September 14, 1987; Newton Square, Penn.
Sumner K. Wiley, Sr., '18; December 6, 1987; So. Harpswell, Maine.
Morton A. Smith, '19; December 13, 1987; Great Barrington, Mass.
Edward G. Zahn, '20; 1987; Centerville, Mass.
William C. Gray, '22; June 25, 1987; Plaistow, N.H.
Royal A. Stone, '22; July 28, 1987; Clearwater, Fla.
William B. Greenough, Jr., '23; November 25, 1987; Providence, R.I.
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James H. Grahame, '24; October 25, 1987; Escondido, Calif.
Mark L. Sinnicks, '24; November 14, 1987; Ather-ton, Calif.
Robert L. Dietzold, '25; November 10, 1987; Sum-mit, N.J.
Edward H. Fish, '25; August 3, 1987; Ridgewood, N.J.
Elzear N. Gougeon, '25; May 2, 1987; St. Laurent, Canada.
Earl E. Grover, '25; 1985; Fort Lauderdale, Fla.
William H. Callahan, '26; November 16, 1987; Franklin, N.J.
Wesley C.L. Hemeon, '26; January 4, 1988; Indi-anapolis, Ind.
Malcolm S. Hird, '26; May 25, 1984; Rockport, Mass.

Francis E. Walsh, '26; June 26, 1987; Westfield, N.J.
Franklin T. Kurt, '27; October 3, 1987; Brooksville, Maine.
Hilda Young, '27; December 25, 1987; Gambier, Ohio.
D. Thurber Bridges, '28; December 21, 1987; Kit-tery, Maine.
Charles J. Maguire, '28; August 24, 1985; Scottsdale, Ariz.
James E. Ryan, '28; November 21, 1987; Lakehurst, N.J.
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Ludwig C. Hoffmann, '29; 1985; McLean, Va.
John C. Macy, '29; February 8, 1986; Kinnelon, N.J.
Joel M. Whitney, '29; November 23, 1987; Santa Rosa, Calif.
Arthur Heifetz, '30; November 12, 1987; Andover, Mass.
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John L. Lawson, '31; December 23, 1987; Memphis, Tenn.
Charles Ernest Loucks, '31; December 17, 1987; Ar-lington, Va.
Eugene J. Lourie, '31; May 27, 1987; Birmingham, Mich.
Byron N. Martin, '31; December 12, 1987; South Dennis, Mass.
John P. Cogan, '32; August 14, 1987; Houston, Tex.
George E. Murray, '32; November 22, 1987; Lex-ington, Mass.
John Navas, '32; October 19, 1987; Los Angeles, Calif.
William E. Conant, '33; September 20, 1987; Wil-mington, Del.
Richard T. Hodgdon, '33; November 15, 1987; Wakefield, Mass.
Robert L. McCormack, '33; November 21, 1987; Longwood, Fla.
William V. Reed, '33; April 16, 1997; Sarasota, Fla.
Robert H. Taylor, '33; May 5, 1985; New York, N.Y.

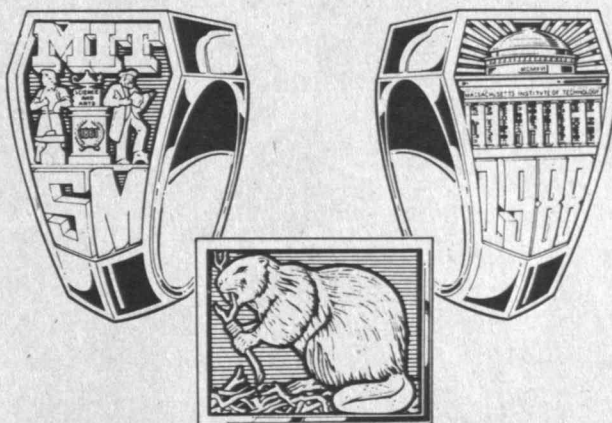
Felix A. Vogel, Jr., '33; June 16, 1987; Houston, Tex.
William F. Fell, '34; August 29, 1987; Merchantville, N.J.
Henry W. Mertens, '34; November 4, 1987; Man-chester, Maine.
John S. Stevenson, '34; September 7, 1987; Quebec, Canada.
Percy Ehrlich, '35; November 21, 1987; Newtonville, Mass.
Fred M. Kraus, '35; December 12, 1987; Stamford, Conn.
Richard L. Parli, Sr., '35; October 10, 1987; Arling-ton, Va.
Herbert Oscar Solibakke, '35; November 1987; Bak-ersville, N.C.
Raymond B. Healy, '36; November 28, 1987; Cold Spring, N.Y.
Albert A. Woll, '37; August 8, 1987.
Reed Freedman, '38; November 30, 1987; Hyde Park, Mass.
Jackson Graham, '40; 1987; Palm Springs, Calif.
Hans Otto, '40; June 1987; North Palm Beach, Fla.
Robert V. Higdon, '42; August 8, 1987; Rohnert Park, Calif.
Charles S. Ricker, '42; August 7, 1987.
S Young Tyree, Jr., '42; July 17, 1987; Floyd, Va.
Edward E. Ernst, '43; February 24, 1980; Anaheim, Calif.
George M. Armstrong, Jr., '45; October 15, 1987; Wyckoff, N.J.
Stanley I. Stevens, '46; November 30, 1986; Green-wich, Conn.
Allen N. Sweeney, '47; December 8, 1987; Oster-ville, Mass.
Aldo C.J. DiMascio, '49; October 1986; Hopewell Junction, N.Y.
Howard K. Kothé, '49; February 2, 1987; New York, N.Y.
Harry J. Lang, '49; June 22, 1987; Anchorage, Ak.
Stephen D. Moxley, Jr., '50; December 30, 1987; Huntsville, Ala.
Audun Ofjord, '50; July 3, 1987; Bergen, Norway.

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DONOR'S PROFILE:

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HOME: Weston, Massachusetts

CAREER: Miss Pierce earned both her bachelor's and master's degrees in architecture from MIT. Since graduating in 1922, she has completed more than 1,000 design projects and, at age 87, continues working from her home office.

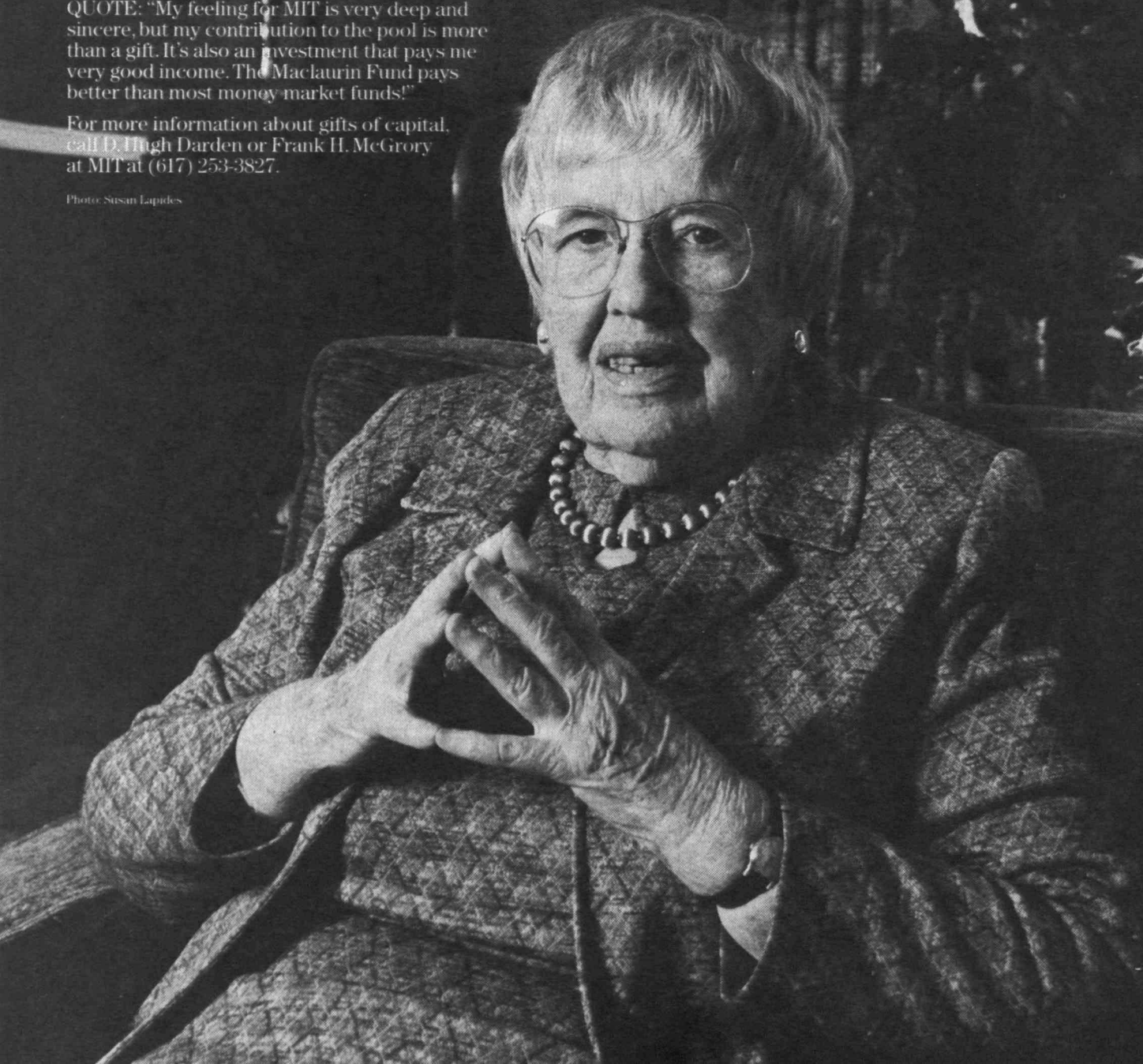
The first woman to serve on the Alumni Fund Board, Miss Pierce is a dedicated supporter of MIT. She was awarded the Bronze Beaver in 1977 for her service to the Institute.

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Photo: Susan Lapides



A DEFENSE DOSSIER: Arkansas's Lesson in B-1 Politics

BY NICK KOTZ

ON no question in recent years have members of Congress been monitored more closely or lobbied more fiercely than on the B-1 bomber. Every congressional vote has been critical, and the air force has counted those votes closely. Senator David Pryor (D-Ark.) found this out when he sought to get a squadron of C-17 troop carriers headquartered at Little Rock Air Force Base.

In the early 1980s, after a Titan missile exploded in its silo at the base, Arkansas citizens wanted to get rid of the aging missiles there. But removing the Titans might mean the base would close, devastating the local economy. The well-organized Little Rock Community Base Council implored Pryor to help get the C-17s as a replacement.

On May 15, 1984, Pryor met with Brig. Gen. James McCarthy, the air force's congressional director of legislative liaison, and Col. Kenneth Anderson, the legislative liaison officer for the Senate. Pryor carefully spelled out why Little Rock should get the C-17s: the base was already the principal training facility for the airlift command. It enjoyed broad community support and was important to the local economy.

Finally he got to the point. "Well, general, how do our chances look on the C-17s?"

"You know, Senator," McCarthy said, "there are a lot of members of Congress interested in getting those planes."

"General, do you mean

that politics are involved in these base decisions?"

"Well, you know, Senator, your positions in many quarters are considered anti-military," replied McCarthy.

"General, why don't you give me some examples of what you are talking about?" said Pryor.

The general hesitated, then observed that Pryor had opposed construction of the B-1 bomber. "We've been over that before," said Pryor. "You know that I've supported the stealth bomber. What else?"

Gen. McCarthy turned to Anderson. "Colonel, give me the senator's vote sheet," he ordered. Anderson's face reddened as he handed the general a thin folded document. Gen. McCarthy began ticking off issues on which Pryor had differed with Defense Department policy.

"Let me see that thing," said Pryor.

What the general reluctantly handed him was a two-page computer printout titled "Senator Pryor: Floor Statements and News Items." It listed 17 separate items. It noted that he had opposed the B-1 bomber, had "led the fight against nerve-gas production," had been "critical of defense contractors for hiring former Defense Department personnel," and had criticized President Reagan for violating the War Powers Act. From a narrow Defense Department viewpoint, the only "pro-defense" items on Pryor's report card were his support for the stealth bomber and three speeches in favor of the C-17.

Pryor was astounded. "This sort of reminds me of an FBI dossier," he said.

When the meeting ended, the base issue was still not settled, but Pryor had gained a deeper appreciation of how seriously the military plays

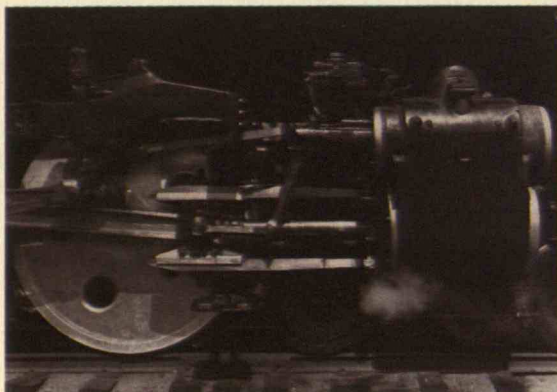
defense politics. McCarthy had broken the rules of the game: exert pressure subtly, but never let members of Congress know they are being graded by the Pentagon.

Indeed, the Defense Department sometimes rates members of Congress on a point basis, much as do labor unions or business groups. Moreover, such practices have gone on for years. The military routinely violates Title 18 of the U.S. Code, which forbids officials of the executive branch from lobbying members of Congress. In the pristine purity of the law, military officers, just like officials of the Agriculture Department, should only supply information Congress requests. In reality, though, presidents and members of their administrations, including those in uniform, engage in a mutual game of arm-twisting with Congress, trading favors and votes. □

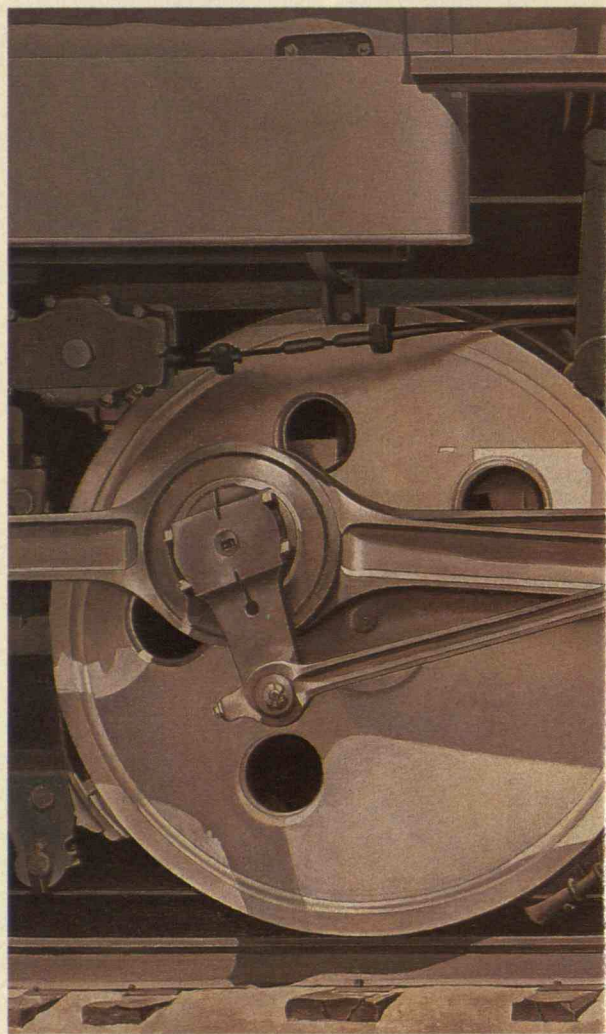


After a Titan missile exploded in its silo, Arkansas citizens wanted the air force to remove the rest of the aging missiles.

*In paintings and
photographs,
American artist
Charles Sheeler
captured the abstract
beauty of industrial
technology.*



WHEELS, 1939
Museum of Fine Arts
Boston, Mass.

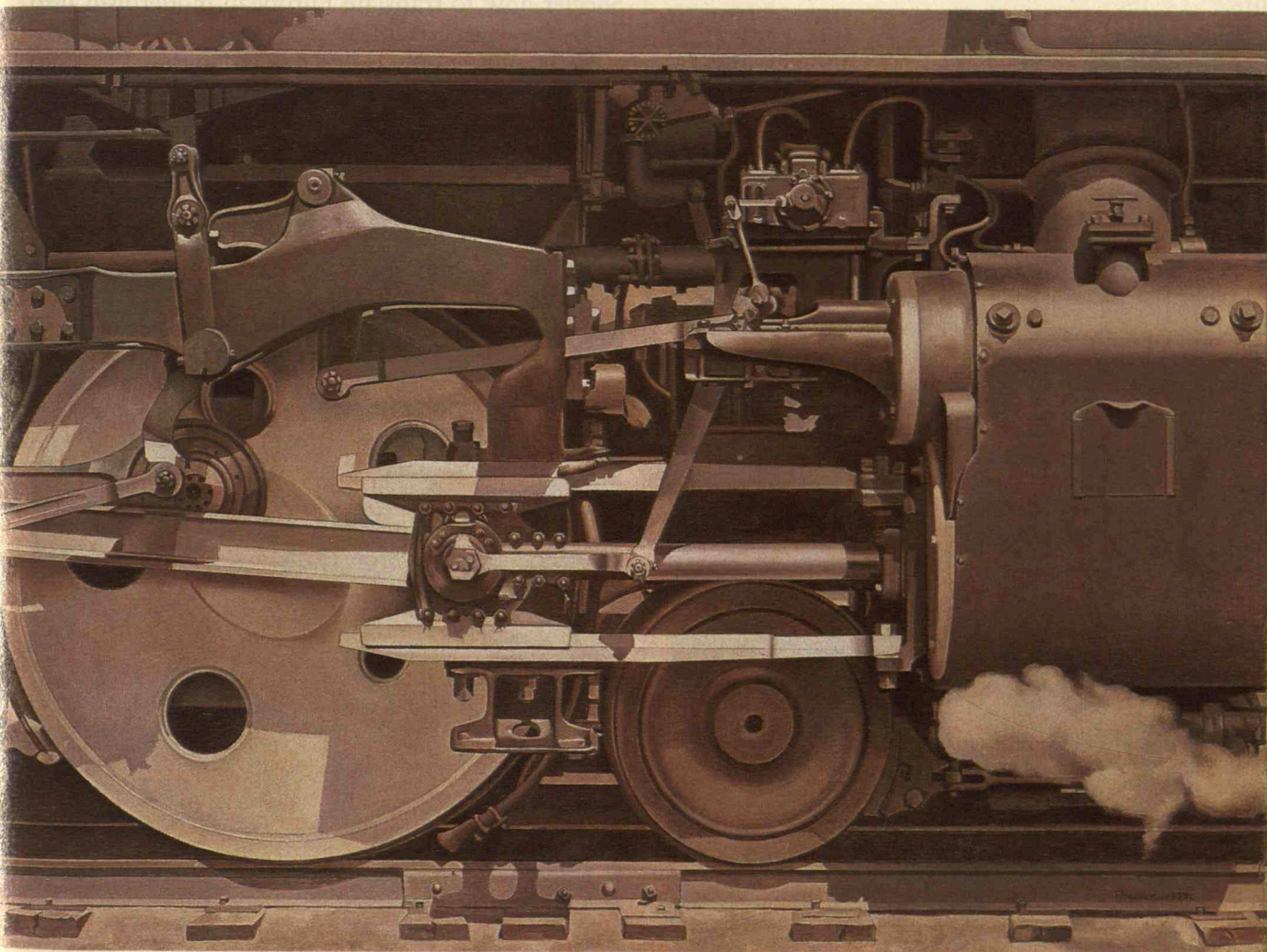


ROLLING POWER, 1939
Smith College Museum of Art
Northampton, Mass.

CHARLES SHEELER:

Master of the Industrial Sublime

BY REBECCA NEMSER



THIS PHOTO-
GRAPH AND
PAINTING OF A
HUDSON LOCO-

MOTIVE BEAR
SHEELER'S ARTISTIC
SIGNATURE:
SIMULTANEOUS

ATTENTION TO
REALISTIC DETAIL
AND ABSTRACT
COMPOSITION.

The cultural history of the twentieth century has been profoundly shaped by encounters of modern art with the technology of the industrial age. Constructivism's belief in abstract art as an emblem of a rational technological future, Futurism's fascination with the speed and elegant simplicity of machines, the Bauhaus school's attempt to design machine-made products that were simultaneously beautiful and functional, Le Corbusier's "machines for living"—all reflect a preoccupation with technology as a fundamental symbol of modern life.

One of the most interesting American artists to explore this encounter between technology and art was the painter and photographer Charles Sheeler (1883-1965). Technology was one of Sheeler's most frequent subjects. Indeed, his entire aesthetic vision was informed by his experience with that most technical of visual arts—photography. With paintbrush and camera, Sheeler created powerful and original images of the modern industrial landscape.

The Boston Museum of Fine Arts recently organized the most comprehensive exhibition ever of Sheeler's work. The exhibit is at the Whitney Museum of American Art in New York from January 28 to April 17 and will travel to the Dallas Museum of Art in May.

Learning How to See

Charles Sheeler was born in Philadelphia and studied painting at the Pennsylvania Academy of the Fine Arts with leading American Impressionist William Merritt Chase. On a trip to Europe in 1908, he discovered modern art. Sheeler learned from the paintings of Picasso, Braque, and Cezanne that the responsibility of the artist was not merely to record impressions but to reveal the underlying structure of objects and of reality itself. He was especially impressed with the way the Cubists structured pictorial space as a series of flat, overlapping planes. During

the next few years, Sheeler painted in the styles of several leading European modernists.

Sheeler's discovery of photography in 1910 led him to change dramatically the way he worked. He took up photography to make a living and became a highly respected commercial photographer in New York. He worked for advertising agencies, museums, and art collectors, taking pictures of everything from spark plugs and movie projectors to African masks and the latest modern art. But soon photography became more than just a job. The camera showed Sheeler how to translate European modernism into an original American idiom.

Early photographers had tried to imitate the sense of perspective in Renaissance painting by showing a figure in the foreground, sharply defined against a shadowy background that seemed to recede in space. In his own photographs, Sheeler did just the opposite. Using the camera's capacity to translate three dimensions into two, he flattened things out and emphasized their abstract structure. Sheeler discovered that the camera's ability to create an exact likeness paradoxically gave him the freedom to compose the picture as an abstraction.

Take for example the photograph "New York, Park Row Building." Instead of using shadows to create the illusion of deep space, Sheeler acknowledges the flatness of the picture plane and uses the large shadow on the lefthand side as a design element in an abstract composition. In this way, the camera enables Sheeler to project the flat planes of Cubist space onto images of the actual world. (In January 1921, this photograph appeared in *Vanity Fair* under the headline "Cubist Architecture in New York.")

Sheeler's painting of the same scene, "Skyscrapers," moves even further in the direction of abstraction. Here, he creates a kind of tapestry with the various textures of brick, the patterns of opened and closed window shades, and the passages of light and dark. The close-up view and careful cropping deemphasizes the distance between the buildings and highlights their purely formal relationships. Sheeler provides enough information to make the painting seem realistic, but at the same time he structures it

REBECCA NEMSER is the art critic for WBUR-FM, a public radio station in Boston, Mass.

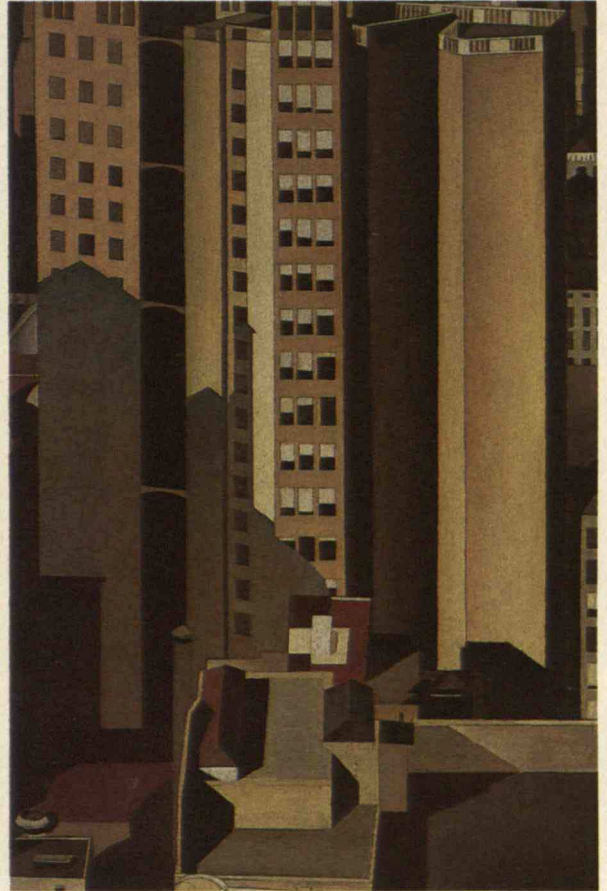
SINCE PHOTOGRAPHY
IS INHERENTLY
REALISTIC, SHEELER
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HE CONCENTRATED
ON ABSTRACT
COMPOSITION.

IN THIS PHOTOGRAPH,
HE USES THE VARIOUS
MASSES OF BUILDINGS
AND THE LARGE
SHADOW AT LEFT TO
PROJECT A CUBIST
PERSPECTIVE ONTO
THE ACTUAL WORLD.

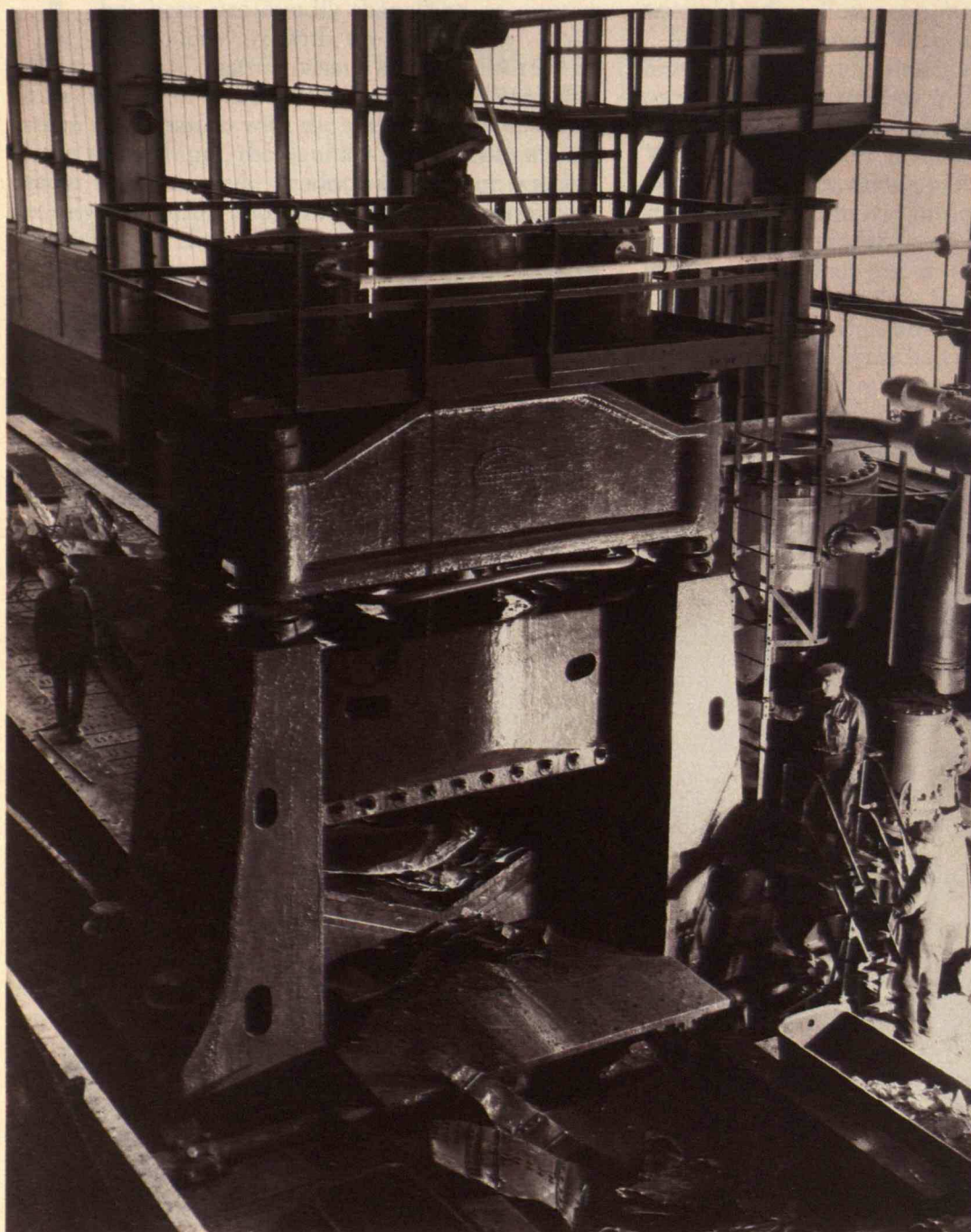


NEW YORK, PARK ROW BUILDING, 1920
The Lane Collection

IN HIS PAINTING OF
THE SAME SCENE,
SHEELER MAKES THE
IMAGE EVEN MORE
ABSTRACT, ELIMINATING
ARCHITECTURAL
DETAILS AND
USING COLOR TO
HEIGHTEN THE
CONTRAST BETWEEN
PURE FORMS.

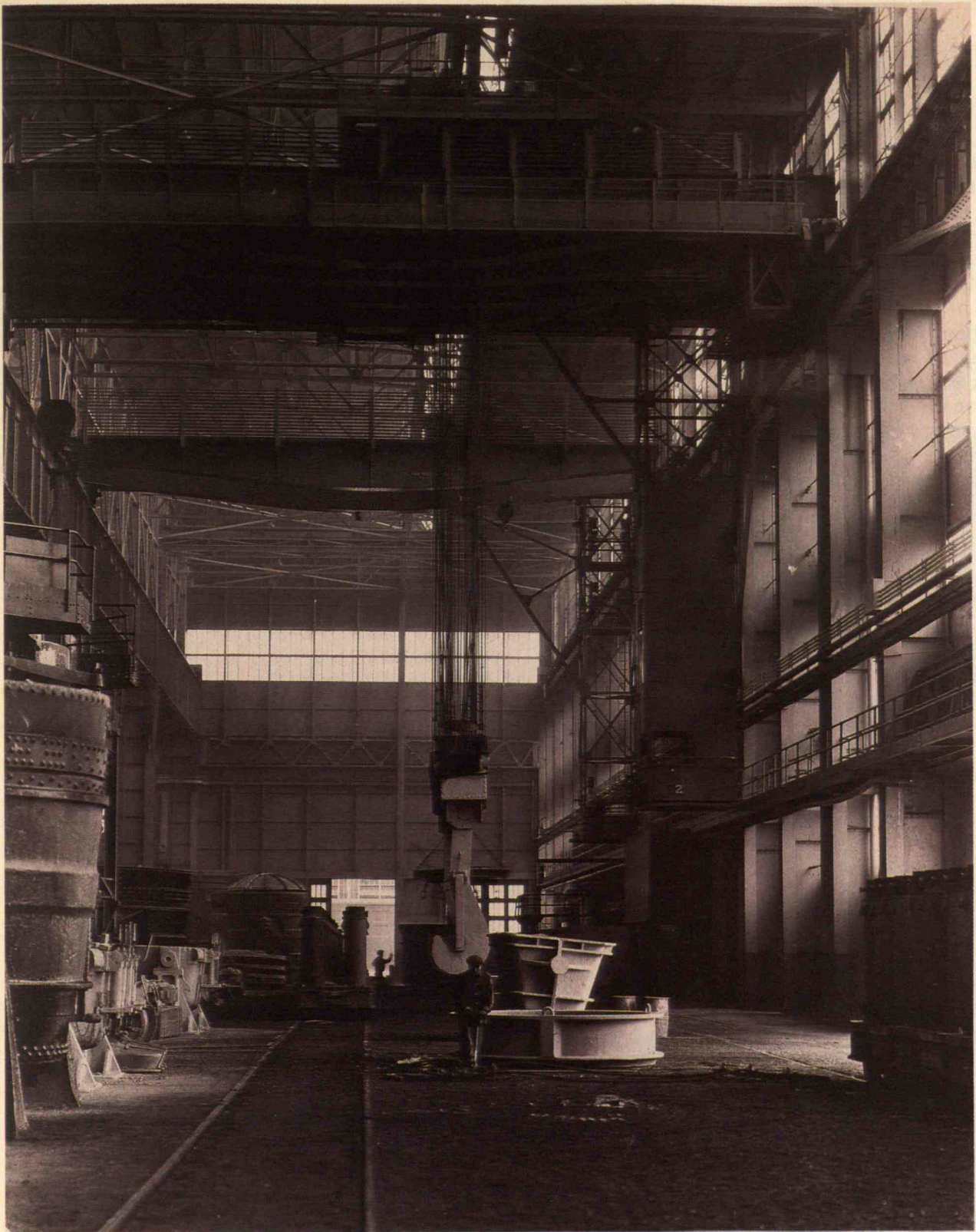


SKYSCRAPERS, 1922
The Phillips Collection
Washington, D.C.



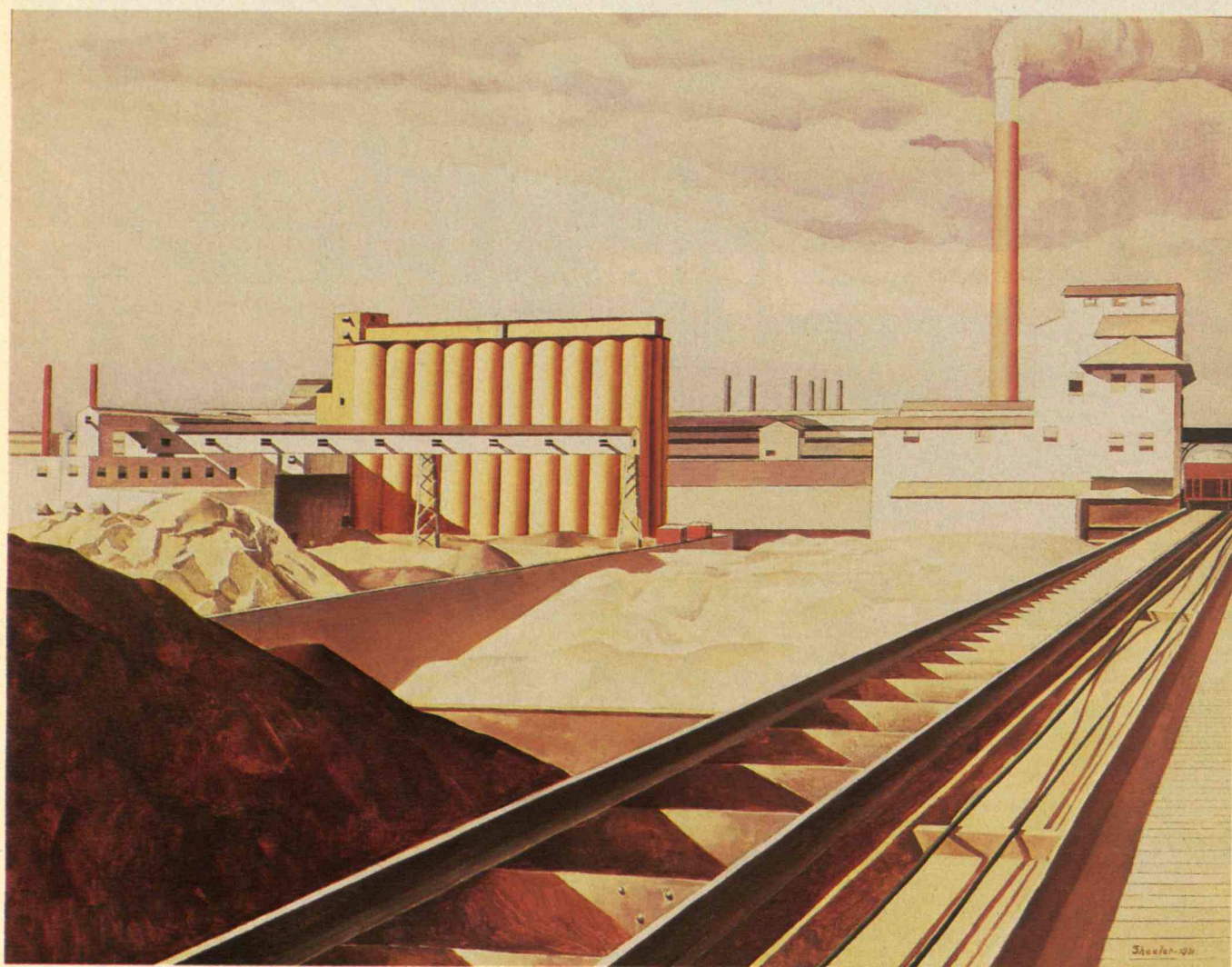
METAL SHEAR—FORD PLANT, 1927
Henry Ford Museum and Greenfield Village
Dearborn, Mich.

SHEELER'S
HAUNTINGLY
BEAUTIFUL IMAGES
OF FORD'S
RIVER ROUGE
PLANT ENDOW
THE MACHINERY
AND THE FAC-
TORY INTERIORS
WITH A SOMBER,
MONUMENTAL
DIGNITY.



LADLE HOOKS, OPEN HEARTH BUILDING—FORD PLANT, 1927
Henry Ford Museum and Greenfield Village
Dearborn, Mich.

IN SHEELER'S
PAINTINGS OF
RIVER ROUGE,
THE FACTORY
COMPLEX FITS
SERENELY INTO
NATURE IN A
MANNER EVOKING
NINETEENTH-
CENTURY AMERI-
CAN LANDSCAPE
PAINTING.



CLASSIC LANDSCAPE, 1931
Mr. and Mrs. Barney A. Ebsworth Foundation

as a powerful abstract configuration of forms.

Sheeler found himself as an artist by looking through the camera's lens. At the beginning of his career, the camera trained his eye and taught him how to see the world in a new way. Later, he used the camera as a kind of sketchbook for taking notes for paintings—he called it his “shorthand.” And in his late work, he actually composed his paintings by projecting photographic negatives onto the canvas. His mature paintings and photographs are clear and realistic images, but they also have an underlying abstract structure that gives them a compelling energy and power.

Sheeler's mastery of each medium enriched the other. Consider the photograph “Wheels” and the painting “Rolling Power.” Both show the crank shafts and driving wheels of a streamlined, coal-powered Hudson locomotive. Both are dramatically cropped and intricately detailed views of complex machinery. But the photograph reveals a painterly sensitivity to nuances of color and tone, while the painting, part of a series on the theme “Power” commissioned by *Fortune* magazine in 1938, has a remarkably sharp, almost photographic accuracy. Both take a moving machine and turn it into a timeless and surprisingly beautiful work of art.

The New American Landscape

As “Wheels” and “Rolling Power” suggest, Sheeler found in technology the perfect subject for his new style. He spent most of his life finding the elemental forms and abstract structures of modern art in America's new industrial landscape—the Machine Age of the 1920s and 1930s, a new world of factories, skyscrapers, silos, and steamships.

Machines fascinated Sheeler. They appealed to his sense of design, his wish to be modern, and his appreciation of simple and powerful forms in complex structures. He saw the same formal beauty in modern technology that he found in the greatest art. He once wrote of his Lincoln automobile that “to sit at the wheel is a revelation. It is to begin over again. The feel and sound of the engine is something to

wake up in the middle of the night and think about. . . . My pleasure in it is akin to my pleasure in Bach or Greco and for the same reason—the parts work together so beautifully.”

So in 1927, when the N.W. Ayer advertising agency sent Sheeler to photograph the Ford Motor Co.'s new River Rouge industrial complex in Dearborn, Mich., he was excited by the opportunity. Designed by the architect Albert Kahn, the Rouge was then the world's largest and most advanced industrial facility. The plant covered 2,000 acres and employed 75,000 people in dozens of buildings. It included 93 miles of railroad track and 27 miles of conveyors moving raw materials. Sheeler wrote, “The subject matter is incomparably the most thrilling I have had to work with.”

At the Rouge, Sheeler made a now-classic series of black and white photographs showing the great looming shapes and shadows of blast furnaces, conveyors, salvage ships, slag buggies, boilers, metal shears, huge ladles pouring hot metal, and other industrial technology. On one level, the photographs are highly detailed portraits that make the machinery look almost alive—like great, prehistoric dinosaurs crouching in a cave. On another, they are beautifully composed abstractions, dominated by bold diagonal lines and slow curves.

A few years later, Sheeler painted what he had seen at River Rouge. While his photographs generally focus on the interior, his paintings show the exterior of the gigantic plant as a panorama of factory buildings, railroad tracks, and huge piles of raw materials such as coal and stone. The paintings are much lighter and more expansive than the photographs. For example, “Classic Landscape” shows the silos of a cement plant and a smokestack in the distance. A long diagonal of railroad tracks, with a frieze of shadows, pushes the focus of the scene back in space. Everything is bathed in a clear, white light that gives the landscape a feeling of classic permanence and monumentality.

The painting conveys the vastness and complexity of River Rouge, yet earth and sky fill more than half the canvas. Sheeler's factories are well anchored in

nature; they occupy a middle ground between earth and sky. The white smoke pouring out of the chimneys parallels the clouds floating above the landscape; there's a sense of harmony and peace.

Sheeler's approach to the industrial landscape echoes that of nineteenth-century American painters to the American wilderness. Artists like Thomas Cole portrayed the vast and awe-inspiring American landscape in a style that came to be known as "American sublime." In Sheeler's industrial landscapes, technological wonders such as River Rouge have taken the place of natural wonders such as the Rocky Mountains and Niagara Falls.

Sheeler conveys a romantic vision of technology in all his work. Like many Americans of his generation, he saw technology as a symbol of progress. It is striking how both the paintings and the photographs of River Rouge are almost entirely empty of people, despite the fact that tens of thousands worked there. The few who do appear in Sheeler's vision of the Rouge are tiny, bent figures dwarfed by the great machines. A photograph like "Ladle Hooks" makes the inside of the factory look almost like a church where technology is worshipped, while "Classic Landscape" turns the silos and smokestack into pure, white forms resembling the columns and spire of a classic New England church.

This reverence for technology becomes explicit in a painting Sheeler made a few years after his work on River Rouge. Entitled "Sky and Earth—Conversation," it is a portrait of Boulder Dam and part of the "Power" series commissioned by *Fortune*. The painting shows a silvery transmission tower soaring up to a brilliant turquoise sky, while the smooth concrete wall of the dam emerges from a mountain of crumbly, dry brown rocks. "Sky and Earth" is sparser and even more abstract than the River Rouge landscapes, and it even more emphatically joins nature and technology.

Fortune described "Sky and Earth" as a kind of altarpiece and, indeed, the transmission tower resembles a great cross placed on a diagonal, slightly off-center—the way a great cross might have been painted in a Baroque crucifixion scene. There are

even two smaller towers in the background, echoing perhaps Rembrandt's great series of etchings called "Three Crosses." Here, technology in the form of the transmission tower is the link between earth and the heavens—a machine of salvation.

Sheeler's Legacy

Today Sheeler's celebration of the machine may seem too romantic. After all, while he was composing his stunningly beautiful industrial scenes, other photographers such as Walker Evans, Roy Stryker, and Russell Lee were documenting the social costs that often accompany rapid social and technological change.

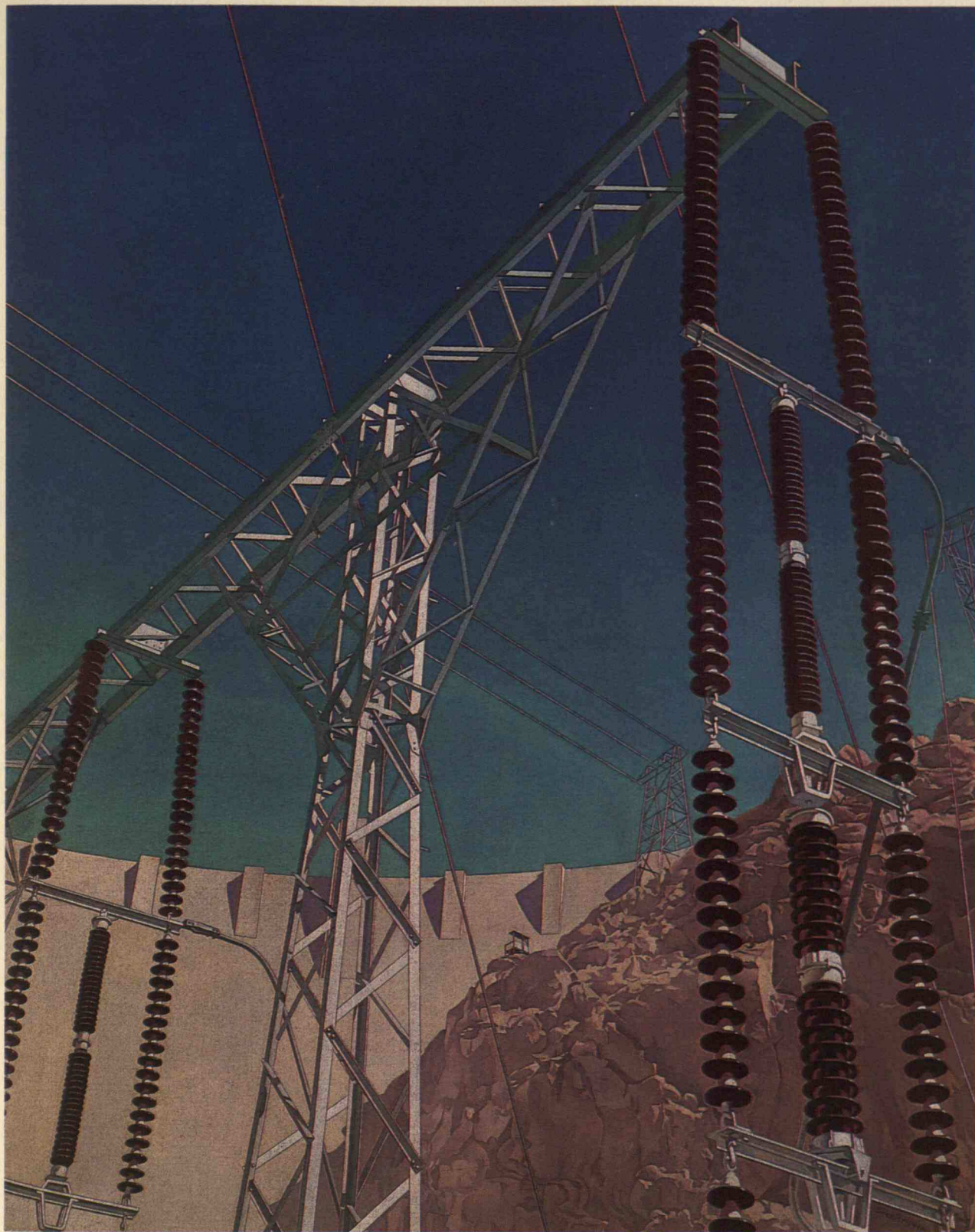
But this doesn't diminish the power of Sheeler's artistic vision. He was inspired by the pure forms and clean lines of modern technology for the same reason that he admired the simple, geometric shapes of early American buildings and household objects, including straight-backed Shaker chairs. In both, he saw the qualities that he wanted in his own art—the ability to speak a language that was straightforward, truthful, and unadorned.

Sheeler's genius was the ability to see the same kind of beauty in art, nature, and the forms of machine-age technology. His art transcends the usual divisions between classic and modern, realism and abstraction, the ancient art of painting and the new art of photography.

Ironically, it may have been Sheeler's capacity to embrace these seeming opposites that allowed his work to be overlooked and nearly forgotten after World War II. He did not easily fit into the new categories arising out of abstract expressionism that, until recently, have governed American art. But a new generation of artists and designers has begun to question pure abstraction, experiment with representation, and rediscover past styles. They have much to learn from the art of Charles Sheeler. □

FOR FURTHER READING

- Theodore E. Stebbins, Jr., and Norman Keyes, Jr., *Charles Sheeler: The Photographs*, Museum of Fine Arts, Boston, 1987.
- Carol Troyen and Erica E. Hirshler, *Charles Sheeler: Paintings and Drawings*, Museum of Fine Arts, Boston, 1987.



CONVERSATION—SKY AND EARTH, 1940
The Regis Collection
Minneapolis, Minn.

IN THIS PAINTING,
SHEELER'S REVER-
ENCE FOR TECH-
NOLOGY REACHES
ITS FULLEST

EXPRESSION.
FORTUNE MAGAZINE
CALLED THE
WORK AN "ALTAR-
PIECE," AND THE

TRANSMISSION
TOWER DOES
RESEMBLE
AN ENORMOUS
CRUCIFIX.



Cutting Production of Hazardous Waste

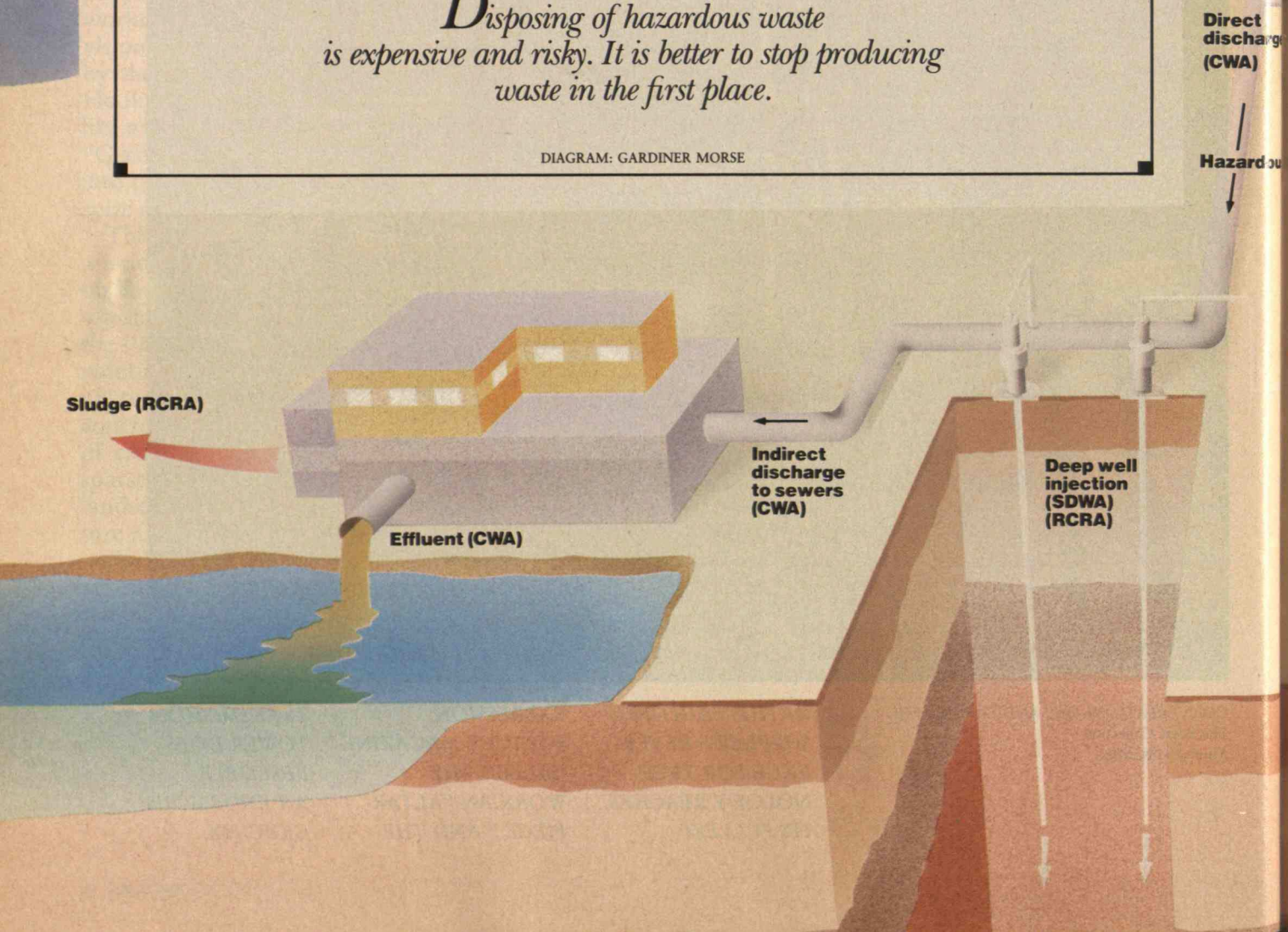
BY JOEL S. HIRSCHHORN

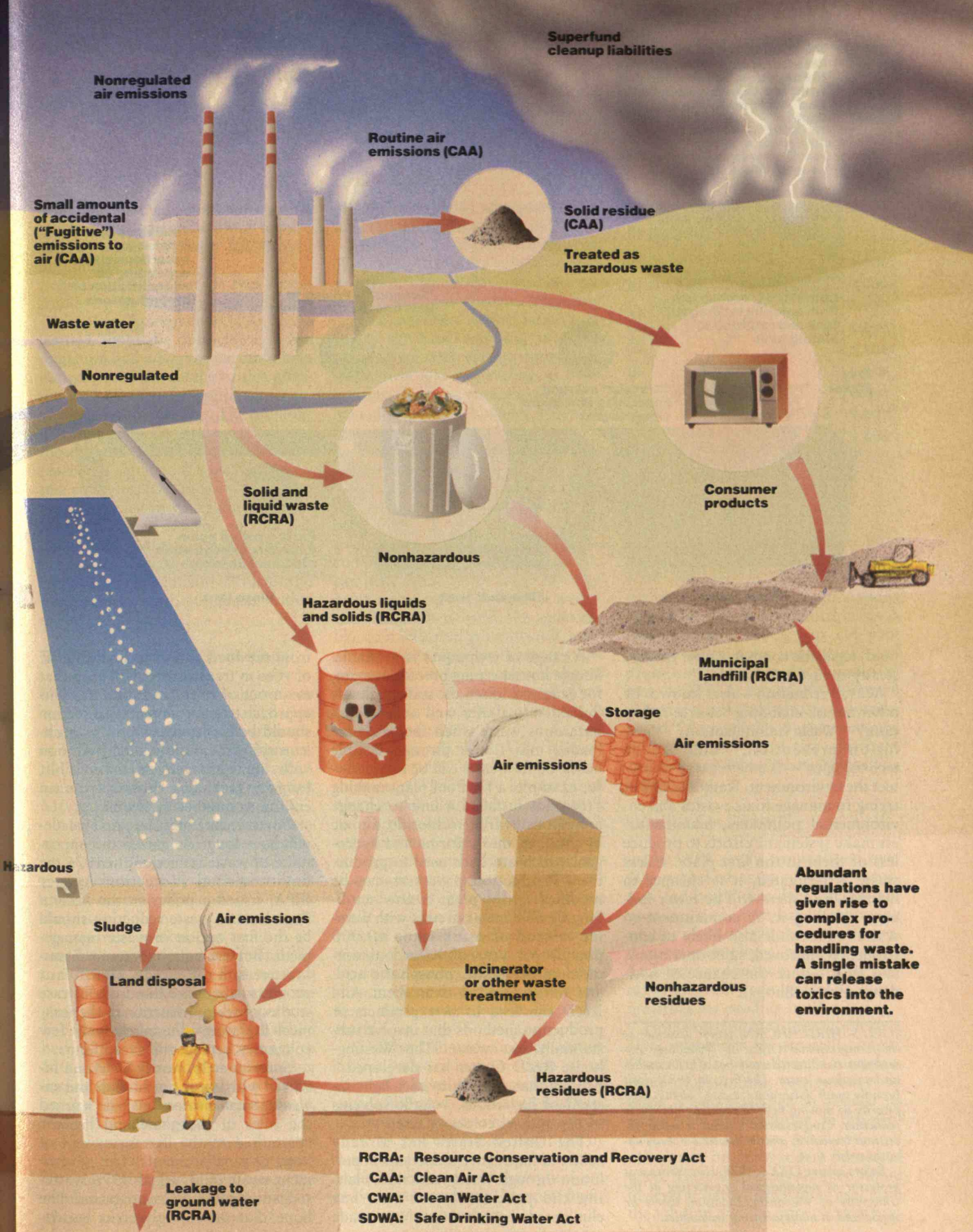
THOUGH the United States has made substantial progress in cleaning up the environment, almost every sector of society has voiced criticism of this effort. As George M. Keller, chairman of Chevron Corp., observed, the passage of Proposition 65, a strict new California environmental

statute, reveals "public distrust, not merely of industry and the potential sources of pollution, but . . . of the regulatory authorities as well." Even the President's Council on Environmental Quality recently stated that the current system to control waste is "marked by substantial noncompliance, delay, . . .

Disposing of hazardous waste is expensive and risky. It is better to stop producing waste in the first place.

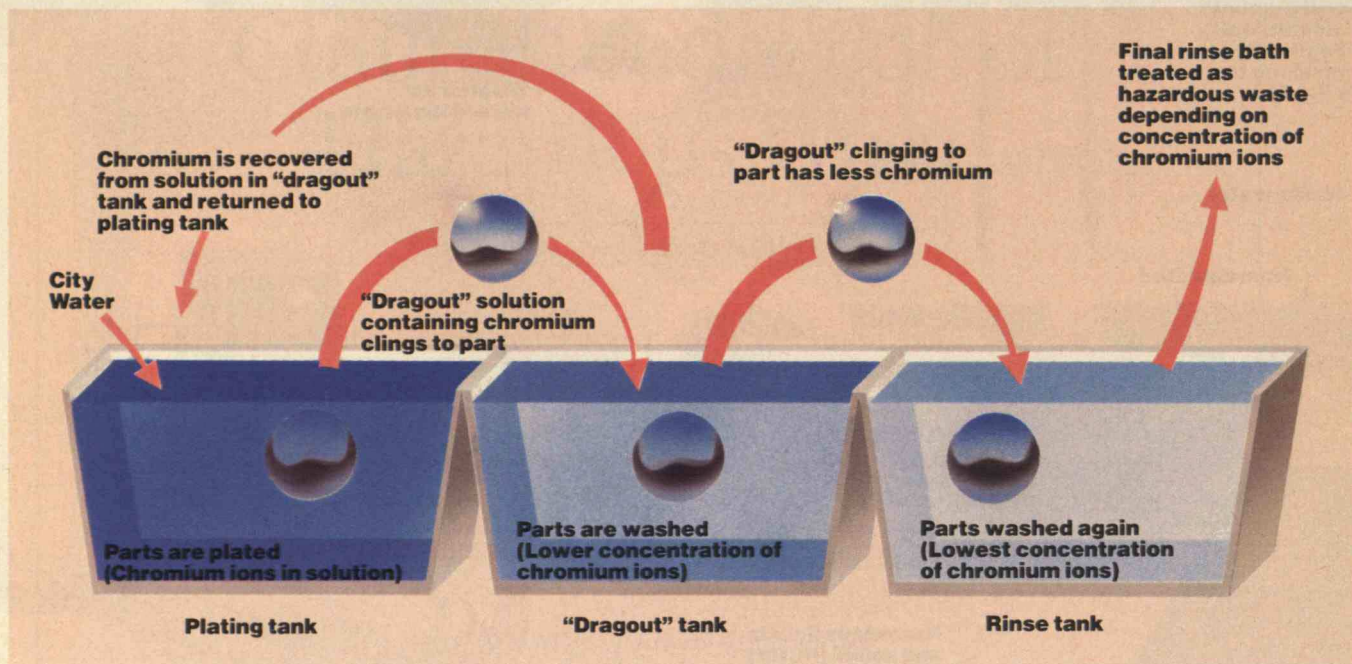
DIAGRAM: GARDINER MORSE







Electroplating produces less hazardous waste if chromium is recovered from the washing solution and returned to the plating tank.



[and] legalistic combat, rather than by steady reduction of toxics."

Waste reduction—also known by other names including "source reduction," "waste minimization," "pollution prevention," and "clean technologies"—is a better way to protect the environment. Rather than just trying to manage toxic wastes and environmental pollutants, manufacturers make systematic efforts to produce less of them in the first place. If less waste is generated, it is cheaper to manage, and there will be fewer failures handling it. A commitment to waste reduction is also likely to contribute to improved, safer operations, and thus reduce the chance of accidents such as Bhopal.

JOEL S. HIRSCHHORN, senior associate at the Congressional Office of Technology Assessment, has directed a number of OTA studies on hazardous waste. The first, in 1983, dealt broadly with hazardous waste, giving high priority to moving beyond regulation to waste reduction. Congressional interest in waste reduction increased, and he directed a study devoted solely to it.

Before joining OTA in 1978, Hirschhorn was professor of metallurgical engineering at the University of Wisconsin, Madison, where he specialized in manufacturing techniques.

A range of techniques is available. Simple housekeeping precautions can, for example, lessen the spillage that is flushed into drains and collected as hazardous waste when chemicals are loaded into trucks through flexible hoses. Some wastes can be recycled—for example, a Du Pont plant making Freon has installed a unit to change anhydrous hydrogen chloride, a toxic by-product, into chlorine and hydrogen, which are both used in production. Production processes can be modified: a 3M plant is now scrubbing flexible metal circuits with pumice instead of using some 40,000 pounds per year of hazardous ammonium persulfate, phosphoric acid, and sulfuric acid to clean them. And R&D can lead to new products or production methods that involve substantially less waste. The Westinghouse R&D Center has developed a process that uses ultraviolet light instead of hazardous, volatile solvents to dry and set colored paints.

The United States has already achieved impressive reductions in pollution through waste reduction. Halting the production of DDT has eliminated the carcinogenic pesticide

from the food chain, and halting use of PCBs in transformers will keep that toxin out of rivers and harbors. This approach to environmental protection should be especially helpful as problems shift from visible, dirty pollution with immediate effects to invisible, long-range health threats from an enormous number of toxins.

Government, industry, and academia have long recognized the importance of waste reduction. In 1976 the Environmental Protection Agency (EPA) issued a policy in the *Federal Register* that waste reduction should be the first option in waste management. But even though some manufacturers have made significant progress—there are hundreds of case studies of waste reduction in the technical literature—these relatively few companies remain the exception.

Unfortunately, nearly everyone involved with waste production and environmental protection has learned the rules of the game and become committed to the current system of "end of pipe" controls. The government never followed its 1976 waste-reduction policy with programs. The hope that increasingly strict regula-



As regulations have proliferated, public and private costs for waste management have risen. There is no end in sight. In 1986 the pages of federal environmental regulations increased more than ever—20 percent. The new total was 8,500 pages.

tions on waste and pollutants would quickly push manufacturers toward serious waste reduction has proved unfounded.

As project director of two recent studies by the Congressional Office of Technology Assessment (OTA), I have learned about the obstacles to waste reduction and what we can do to help industry take advantage of this effective and inexpensive approach to environmental protection. The opinions in this article are my own and not those of the OTA, but the study itself reached a significant conclusion: Setting aside obstacles to waste reduction that may exist in government policy, the organization of firms, and individual habits, it would be technically and economically feasible for U.S. industry to reduce production of wastes and pollutants by up to 50 percent within the next few years.

Why We Need Waste Reduction

Waste reduction is the only way to save industry some of the escalating costs of the current waste-management system. To begin with, there are the direct costs of waste disposal. A ton of hazardous waste that once cost \$10 to manage can now cost \$500.

More precise figures on waste-management costs are often not available, since over 90 percent of wastes are managed on-site by their generators and the costs are not made public. But the prices of off-site commercial waste management indicate the trend. A recent EPA survey found that from 1983 to 1985 the charges for most services provided by waste-management companies rose several hundred percent. For example, landfilling costs that had been \$25 to \$60 per drum jumped to \$50 to \$137. The cost of incinerating liquids that do not readily burn, such as any hazardous waste in water, roughly quadrupled.

This trend will continue. It stems largely from increasingly strict government regulation. In 1986 alone the number of pages of federal environmental regulations increased by 20

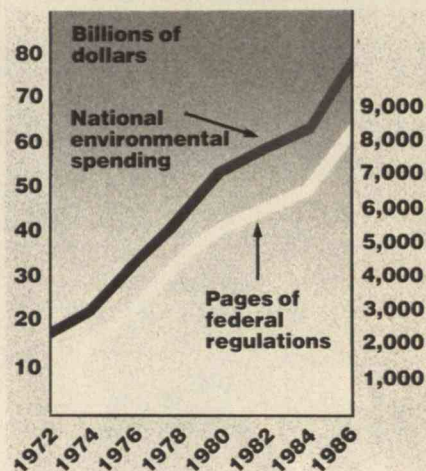
percent, and the list of regulated substances will continue to grow.

Moreover, direct costs are only part of the story. Liability suits can result in multimillion-dollar expenses and keep senior management from productive activities. Many large companies are now spending more on cleaning up and closing hazardous-waste sites and responding to court actions than on managing current hazardous wastes. Liability insurance to cover environmental problems has become difficult to get, loaded with limits, and very costly.

Even improved disposal practices may not prevent liabilities. Many U.S. companies still send hazardous waste to land disposal facilities that, despite compliance with current regulations, can pose risks. Other waste-management techniques may lead to significant liabilities as well. For example, like contaminated groundwater, toxic air emissions from incinerators could become the basis for actions against waste generators, even though accurate tracking of the pollutants is nearly impossible.

The need to make U.S. industry competitive also argues for waste reduction. A 1985 study by the Organization for Economic Cooperation and Development (OECD), a research organization of the developed nations, indicates that other industrialized nations have done at least as well as the United States in reducing pollution while spending less. In 1980, the percentage of gross domestic product devoted to pollution control was nearly four times greater in the United States than in Japan and France, and nearly three times greater than in West Germany.

U.S. firms should consider cost-effective waste-reduction efforts to redress this imbalance. According to a recent EPA study of 28 firms that have undertaken waste-reduction measures, 54 percent found that their investment paid for itself in less than a year, 21 percent found that it took one to two years, and only 7 percent found it took more than four.



Most American managers are concerned only with the direct costs of waste management and pollution control, but in some European nations managers see waste reduction as a comprehensive strategy to cut production costs, spur innovation, and promote international competitiveness. An OECD survey of 200 French companies practicing waste reduction found 51 percent had saved energy, 47 percent had saved raw materials, and 40 percent had improved working conditions.

How To Cut Waste

In the OTA study we analyzed over 300 published cases of waste reduction and noted that five different approaches have been used: improving routine plant operations, altering production technology, recycling waste back into production, changing raw materials, and redesigning or reformulating the product itself.

Housekeeping measures to improve plant operations are generally simple. For example, Stanadyne, a manufacturer of plumbing equipment, has made a small change to reduce its waste from electroplating. In this process, a current causes metal ions in a solution to be deposited on immersed parts. The plated parts are then rinsed in several baths. After their use, both the solution and the rinse become haz-



Byron J. Seelig checks medicine tablets coated in a water-based process that Riker Labs has developed to avoid using solvents. Riker, a 3M subsidiary, spent \$60,000 for the process but saved \$180,000 in pollution-control equipment and cut air pollution by 24 tons a year.

equipment and technology. When 3M stopped cleaning flexible metal electronic circuits with toxic chemicals and started scrubbing them with pumice, as mentioned, it reduced hazardous waste by 40,000 pounds per year and saved \$15,000 annually on raw materials, labor, and disposal. The \$59,000 cleaning machine paid for itself in only three years.

Emerson Electric, a power-tool manufacturer, has automated its electroplating system. The new system increases productivity, saves electricity, and reduces waste, partly through more efficient rinsing of the plated parts. Carrying less electroplating solution into rinsing baths generates less hazardous waste. The \$158,000 investment paid for itself in little more than a year. Wastes from plating have decreased from 450 to 360 pounds per day.

"In process" (also known as "in line" or "closed loop") recycling uses waste for productive purposes, as in the case mentioned of Du Pont's Freon plant that changes toxic anhydrous hydrogen into useful chlorine and hydrogen. Another instance of in-process recycling comes from the printing industry. Most inks are dissolved in toxic organic solvents, and when the solution of ink and solvent splashes, spills, or becomes dirty or contaminated, it must be handled as hazardous waste. Diversified Printing and Donnelley Printing both reuse over 85 percent of the organic solvents that would otherwise be thrown out as hazardous waste.

In-process recycling, employed in 35 percent of the cases we studied, is popular because it uses techniques that are close to traditional engineering and pollution-control practices. Some companies move waste to another location to recycle. Since this requires handling of the material, it is not true waste reduction, but it is preferable to many other forms of waste management.

In 6 percent of our cases, engineers have used different raw materials to

ardous waste. Stanadyne has simply begun inspecting parts before electroplating rather than afterwards. This eliminates the waste from electroplating defective parts.

Exxon Chemical Americas has improved one of its operations by installing floating roofs over tanks of volatile solvents. The roofs, which greatly reduce emissions into the atmosphere, saved enough solvent to pay for themselves in one year.

Borden Chemical has reduced organics in wastewater by 93 percent through better handling of phenol wastes from resin manufacturing. In addition to minimizing spillage in loading and unloading trucks, Borden has improved procedures for rinsing reactor vessels. Since any water used

becomes hazardous waste, workers employ less. They also reuse some of the chemicals washed from tanks.

3M has adopted a sonic cleaning technique to vibrate residue off reactor vessels rather than washing them with large quantities of water. A \$36,000 investment saved \$575,000 in the first year.

Only about 10 percent of our cases noted similar improvements in operations, but the housekeeping approach probably goes underreported, since it is often considered trivial or unsophisticated. Much more than 10 percent of firms that undertake waste reduction probably use such inexpensive and effective measures.

In about 31 percent of our cases, engineers have altered production



BELOW LEFT: By 1986, 3M had saved almost \$400 million through waste-reduction measures. **BELOW RIGHT:** Eastman Kodak has steadily cut waste from the first step of its process for manufacturing photographic paper. The result has been less waste down the line.

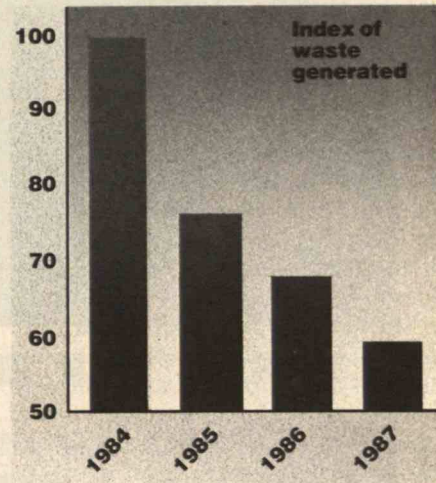
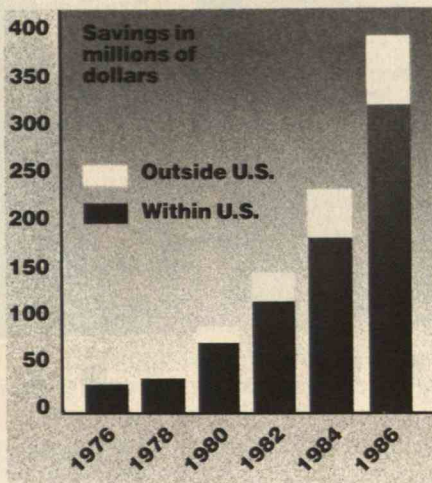
reduce waste, and in 1 percent of the cases, products have been redesigned or reformulated. These approaches are technically difficult. They require special care because they might affect the quality of the product, and they involve people outside of the production operation, including in R&D and marketing.

One example of reformulating a product comes from Cleo Wrap, a printer that has developed water-based inks to avoid disposing of hazardous solvents. A six-year conversion project has allowed the company to virtually eliminate hazardous waste and save \$35,000 in waste-disposal costs annually. The project has made underground storage tanks and other measures to comply with new regulations unnecessary, and it has lowered fire-insurance premiums.

Mitsubishi Semiconductor America has replaced chlorinated solvents for cleaning printed circuits with an electrochemical process that produces no hazardous waste. The circuits are dipped in a bath and a current is passed through it—Mitsubishi considers details of the process proprietary and has not released them. In another example, Dow Chemical has packaged an insecticide in a water-soluble material. This eliminates the metal container, which became hazardous waste because of the insecticide remaining inside it.

Waste reduction is best adopted in stages. First come common-sense measures that are readily visible and easy to implement in days or weeks. Such measures—largely improving operations or recycling waste—do not require significant investments yet provide large returns.

Next, the same sort of measures are carried out more systematically. This requires more subtlety and a better understanding of where waste is generated and how it can be reduced. But still, relatively little effort and money can lead to quantum improvements. Government agencies, such as North Carolina's Pollution Prevention Pays



Program and the Environmental Health Department in Ventura County, Calif., can provide useful information on what techniques have been successful in certain types of processes, such as degreasing or electroplating.

Further waste reduction demands more capital investment and personnel time, and payback periods are longer. A formal analysis, or waste-reduction audit (WRA), is required to identify how all hazardous substances are produced, determine the technical feasibility of numerous waste-reduction options, and weigh the economic paybacks. Production personnel and outside consultants may have to spend substantial time on the WRA, which may cost tens of thousands of dollars. At Eastman Kodak the initial audit took three years. But a WRA is key to pursuing waste reduction.

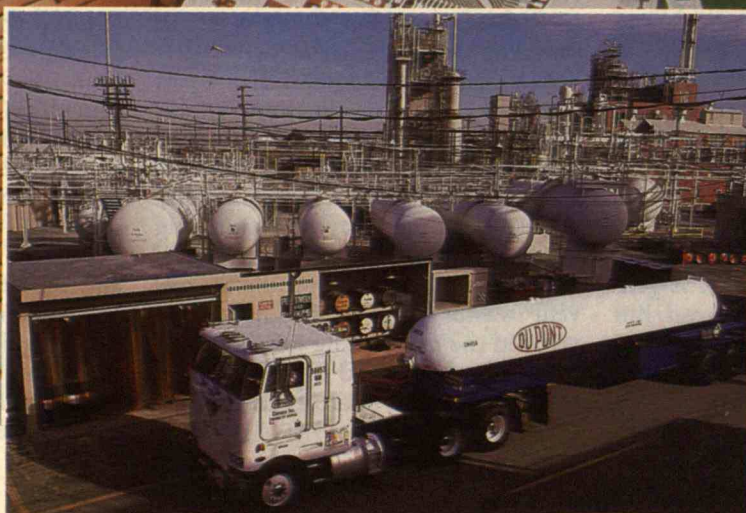
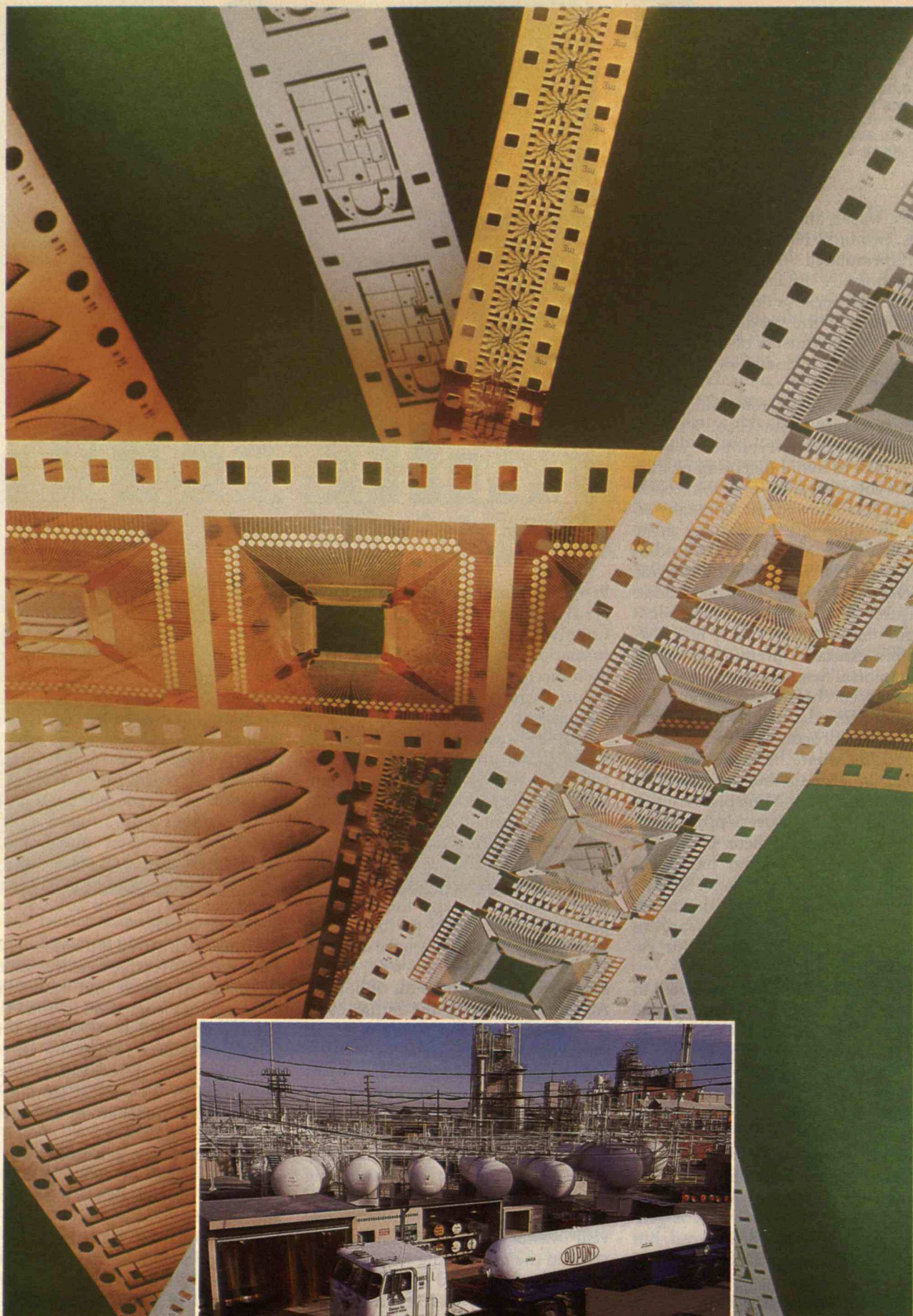
The final stage requires significant R&D to change production technology and possibly the product itself. There is always the danger that the R&D will not pay off, but sometimes there is no other way of eliminating large waste streams. Coating products with paint inevitably produced solvent wastes until Westinghouse developed the new setting process using ultraviolet light. And Cleo Wrap had to reformulate its ink to get rid of hazardous waste.

Are We Reducing Waste?

Most information about the extent of waste reduction is anecdotal. 3M has been the most vocal about its efforts, and its results are impressive. The company says it saved about \$300 million from 1975 to 1985 and cut waste by some 50 percent in its U.S. operations. Yearly production of air pollution was reduced by 110,000 tons, sludges and solid waste by 290,000 tons, water pollutants by 13,000 tons, and total wastewater by a billion gallons. Waste reduction also saved the equivalent of 250,000 barrels of oil a year.

Some other companies have achieved impressive results. Exxon Chemical Americas and Rohm and Haas say that from 1984 to 1985 they reduced the amount of waste for a given production volume by 10 percent. Olin says it reduced its waste generation by 34 percent from 1981 to 1985, and Monsanto by 20 percent from 1982 to 1984.

But companies generally provide very little detail on what they have done, the obstacles they have faced, and the benefits they have obtained. Many companies fear that government regulators may use information about waste reduction against them. Companies may say a little about a specific success (hardly ever a failure)



LEFT: 3M cleans copper conductors in electronic circuits with rotating brushes that use pumice. In the past, relying on chemicals to do the job created hazardous waste.

INSET: This Du Pont plant, which manufactures Freon, employs equipment to convert anhydrous hydrogen chloride, a toxic by-product, into useful chlorine and hydrogen.

but virtually nothing about an entire plant or division, especially in terms that indicate how well they have done in reducing overall waste, or how efficient their expenditures have been.

Another barrier to evaluating nationwide waste-reduction efforts is that systematic national statistics on the generation of hazardous waste and pollution have not been reliable. As a result of changes in the Resource Conservation and Recovery Act and the Superfund law, the EPA is implementing new requirements for reporting waste generation and reduction, and some states are doing the same. Thus, data should improve. However, better waste-generation data could also be misleading. New regulations continually reclassify what is considered waste. Changes in a company's production levels affect the volume of waste. Even shifts in waste-disposal methods may artificially alter the data—if a solvent is allowed to evaporate, it may no longer be counted as hazardous waste.

Nevertheless, available information indicates that only a few American manufacturers have seriously pursued waste reduction. A study by Illinois of 275 companies concluded that in 1985 over 50 percent of hazardous-waste generators had not yet begun serious waste reduction. A study by a California public-interest group of over 100 small metal platers found that 75 percent were not implementing waste-reduction plans in 1986. In a study by New Jersey of 22 firms, 41 percent said they had implemented waste reduction from 1981 to 1985, and 36 percent said they would in the future. The OECD study that demonstrated the benefits of waste reduction also concluded that neither U.S. nor European manufacturers have widely adopted it.

Obstacles to Change

Why should change come so slowly? For more than a decade, a few professors and people in industry have talked about pollution prevention.

Corporate managers and government regulators have made lists of the ways to manage hazardous waste, and waste reduction is always at the top. But it takes a lot to reprogram the thinking of skeptical plant managers and engineers.

One problem is the simple failure to define waste reduction. This may cause traditional waste management to be done in the name of some right-sounding slogan. In a survey by Dana Duxbury, a researcher at the Center for Environmental Management at Tufts University, more than half the companies counted incineration as "waste minimization." And in a recent presentation, representatives of Olin Corp. described four major "waste minimization" efforts: a wastewater treatment plant, a cyanide-waste treatment plant, an incinerator, and a facility to turn wastes into a concrete-like material that can be buried. These steps would reduce the "generation" of hazardous waste by 9,900 cubic yards per year and save \$465,000 annually, the company said. But they are waste-management methods, not waste reduction. The true saving is in off-site waste-management costs.

Waste-reduction proponents have to compete against experienced corporate advocates of other responses to environmental requirements, as well as the majority who cling to the status quo. Lobbyists seek to change laws. Lawyers find opportunities for avoiding or delaying compliance. Engineers would rather add another piece of equipment to control pollution or treat waste—an approach also supported by suppliers of such equipment. Citizen opposition to land disposal provokes management interest in finding loopholes, such as using Indian tribal lands. Sometimes hopelessness about increasing waste-management costs leads to plant closings.

Corporate structure itself poses an obstacle to waste reduction. Plant personnel must implement waste reduction, but they naturally tend to focus on manufacturing the product rather

than reducing waste. This tendency is aggravated by the fact that they are not responsible for the economic consequences of waste. Those who know best what today's environmental costs are and where they are heading—personnel responsible for complying with environmental regulations—cannot implement waste reduction.

Engineers often react defensively to discussions on waste reduction, as if outsiders had just discovered something well known to them. They often believe that by increasing the amount of product made from a given amount of raw material, they have minimized waste. This is incorrect. For one thing, efforts to maximize product yield do not necessarily result in less dangerous types of waste, and for another, these efforts may ignore small quantities of waste. For example, a standard "mass balance" at a USS Chemicals plant missed a 0.06 percent loss of cumene—but that amounted to 400,000 pounds a year. Disposal costs and liabilities for such quantities may be substantial.

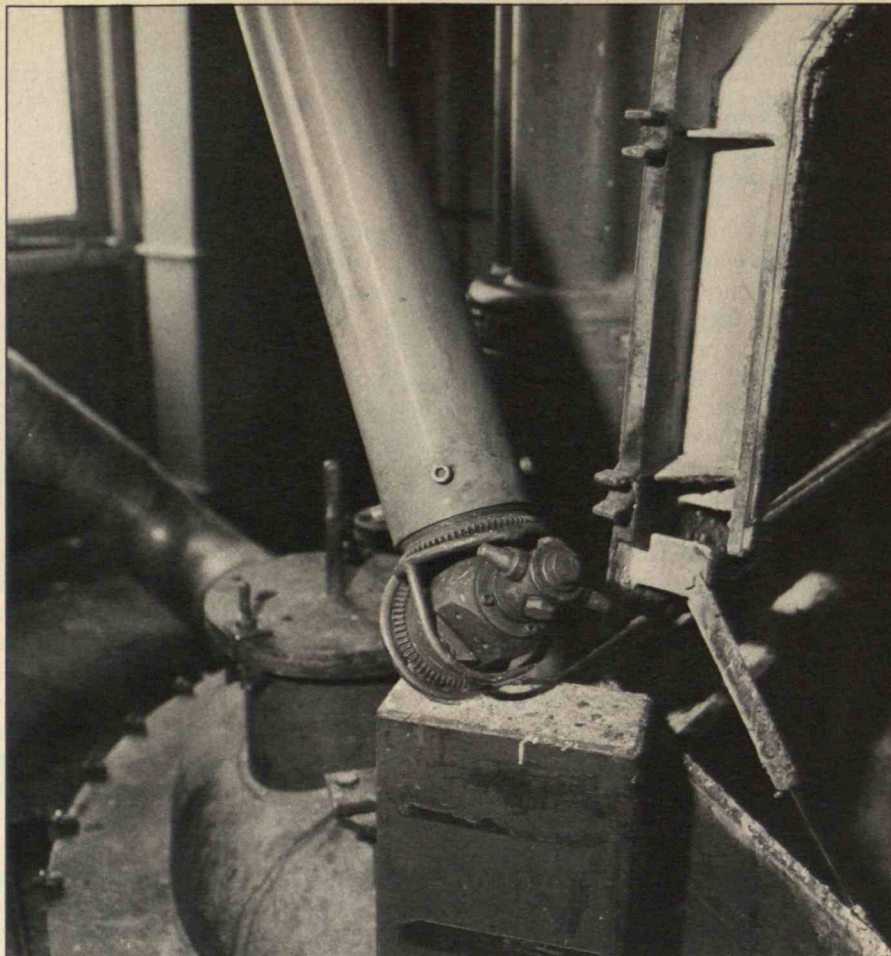
Production people often fear that waste reduction could harm the product. Experience has shown that there is little risk of this. In the early stages, a good company program helps personnel find opportunities to reduce waste without going beyond normal production parameters. Sometimes a minor R&D effort can show how to change production safely. Techniques such as better controls on chemical processes specifically aim to improve quality and reduce the amount of material rejected, which is hazardous waste. Only the final stage of waste reduction, requiring significant R&D, focuses on changes that could affect a product's quality. But the R&D explicitly addresses questions about the matter.

Six Steps to Waste Reduction

Waste reduction requires the total commitment of senior management. In addition, companies that have made substantial progress in waste re-



This rotating spray head is part of a fully automated system for cleaning 300-gallon tanks at 3M's Hilden, West Germany, plant. Since solvent is pumped into the tanks under high pressure, less is needed. The system, which includes solvent recovery, cost \$69,000 and saved \$61,500 in solvent and labor costs in a year.



duction have one or more visible champions of it. Ryan Delcambre, for example, has this role at Dow Chemical. He promotes waste reduction at company plants and discusses the program with outsiders. He started out as a process engineer at Dow's Louisiana plant, and his success in reducing waste there made it clear that he was just the right person to help educate and motivate others.

A corporate waste-reduction program with a strong start can lose momentum unless obstacles are dealt with successfully. Six steps are necessary:

- ☐ Transfer the economic motivation for waste reduction to those engaged in the manufacturing process. Production must be held accountable for the costs of managing wastes—not only for initial treatment and disposal but for any future liabilities and cleanup. Side benefits of waste reduction, such as energy savings, improved worker health and safety, and reduced insurance premiums need to be included in economic analyses.

- ☐ Conduct and maintain a waste-reduction audit. As mentioned, shifting everyone's attention from waste management to reduction requires the systematic analysis of a WRA. However, simple WRAs are sufficient for the early stages. Detailed ones are only needed later on.

- ☐ Make waste reduction a lasting part of corporate culture. Rewrite job descriptions to create a waste-reduction ethic. Du Pont tells employees they need to reduce waste now in just as major a way as they reduced energy use over the last decade. Management policy holds that waste reduction is a line function in manufacturing and not the responsibility of an environmental staff.

- ☐ Motivate employees. Management needs to set specific waste-reduction timetables. Success in meeting such goals should be included in the performance rating that determines salary. Suggestions for waste reduction, even ideas that are unsuccessful, should be rewarded. Training should be provided to help employees iden-

tify waste-reduction opportunities. In addition, employees should be reassured that waste reduction is a new endeavor. Otherwise, some may not take actions fearing that managers will ask why they were not taken earlier.

- ☐ Transfer knowledge throughout the company. Many waste-reduction measures seem simple, but they may not be obvious to everyone. Nor do employees necessarily perceive the cumulative benefits of many small actions. Newsletters and meetings can help disseminate information. Individuals such as Dow's Ryan Delcambre can share experiences among plants. Production people can participate in waste-reduction audits at other plants.

- ☐ Seek technical assistance from outside sources. Even if such expertise seems unnecessary, an outsider can interject a fresh attitude into an operation and support what waste-reduction proponents inside a company are saying. However, the greatest expertise about the sources of



The 3M industrial-tape plant in Knoxville, Iowa, has installed a pipe to catch solvent vapors. They are sent to plant boilers as supplemental fuel. Modifying boiler facilities cost \$270,000 and saved \$155,000 in energy costs in the first year.

waste lies with production personnel, and consultants should channel this expertise toward waste reduction. They should have a background in production, not just environmental engineering. And they need to consider broad company policies, organization, and decision-making procedures, not only specific problems.

To help companies reduce waste, state and federal agencies should strengthen programs offering technical assistance. So far these have been primarily on the state level. North Carolina offers technical assistance, a database of information from companies on reducing waste, and even grants for R&D to implement waste reduction. For two years, Ventura County, Calif., has run a program providing technical assistance to about 100 companies. During that time, off-site management of hazardous waste has dropped by 70 percent. This includes 15 percent true waste reduction, 15 percent recycling outside of the plant, and a 40 percent shift

to on-site waste treatment.

The EPA is setting up an on-line database on waste reduction. The EPA and the states of Illinois and Maryland are also developing "expert systems"—computer programs embodying some of the abilities of experts—to assist engineers in implementing waste reduction. In the 1988 fiscal-year budget, Congress provided EPA with funds for its own waste-reduction activities and \$4 million for grants to state programs.

Some state regulatory agencies are beginning to integrate waste reduction into their regular activities. For example, when New Jersey issues a permit to allow ordinary discharge of pollutants into the air or water, it now asks to see waste-reduction plans. This is a positive trend, but if it continues, companies may be concerned about whether government personnel providing technical assistance will also try to detect and report violations of regulations. Some state waste-reduction programs have tried to prevent this problem by keeping their

technical-assistance programs outside of their regulatory agencies or at least in a separate unit within a regulatory agency. For instance, Minnesota uses its state university and Illinois and Massachusetts have non-regulatory environmental agencies. □

SUGGESTIONS FOR FURTHER READING:

Office of Technology Assessment, *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency*, September 1986; *From Pollution to Prevention: A Progress Report on Waste Reduction*, June 1987.

Michael G. Royston, "Making Pollution Prevention Pay," *Harvard Business Review*, November/December 1980.

David Sarokin et. al., *Cutting Chemical Wastes*, Inform, New York, 1985.

National Research Council, *Reducing Hazardous Waste Generation*, 1985.

OECD, *Environmental Policy and Technical Change*, 1985.



*An unprecedented web of government rules
is limiting the free exchange of information
and ideas in the U.S.*

The Dangers of Information Control

FOR the past decade, the federal government has established a network of policies that restrict the availability, shape the content, and limit the communication of information. This net includes an expanded classification system, limits on the exchange of unclassified information, the use of export controls to restrict technical data, and restraints on contacts between U.S. and foreign citizens. The architects of the new policy have also curtailed the role of government in both collecting and publishing many categories of scientific and statistical information.

The cumulative impact has been to restrain academic freedom, hamper technological progress, and undermine democratic decision making. Consider the following examples:

☐ In 1983 the White House issued a directive requiring more than 120,000 government employees with access to classified materials to sign a lifetime agreement: they would submit for prior clearance any material they wished to publish.

☐ In 1985, the Department of Defense (DoD) required the Society of Photo-Optical Instrumentation Engineers (SPIE) to restrict atten-

dance at a conference where unclassified papers would be presented to U.S. and Canadian citizens and permanent U.S. residents. Scientists allowed to attend had to sign an "Export Controlled DoD Technical Data Agreement," promising that they would obtain an export license before sharing information from the conference with foreign citizens.

☐ The Federal Communications Commission (FCC) decided in 1986 to publish its proposed actions in the Federal Register only in summary form, making public comment more difficult.

☐ The FBI has asked some librarians to report library users who might be "hostile intelligence people."

☐ In 1984, the Department of Housing and Urban Development (HUD) drafted a research contract with a Harvard scholar that would have required him to submit results of HUD-sponsored research for review 6 months before publication. The scholar would also have had to submit results on related work not funded by HUD. The contract would have given the agency the right to demand that the scholar make "corrections" in data, methodology, and analyses. After months of negotiation, Harvard decided to refuse the contract.

BY JOHN SHATTUCK AND MURIEL MORISEY SPENCE

The trend toward greater control of information is predictable in some respects: information is an important national resource that the government understandably seeks to manage. Nevertheless, the government's efforts in these areas should be fundamentally different from its management of other public resources: it should be guided by a heavy presumption, based on the Constitution and our national history, that open communication and the free flow of information have great social utility. This presumption should be overcome only in particular cases where the government can show a substantial public necessity, such as a concrete risk to national security.

Advocates of extensive government control of information have relied on two justifications. The first is the need to protect national security—a concept that under the current administration has become nearly limitless. The idea that broad categories of information must be kept from hostile ears and eyes has shaped a growing array of government decisions. This philosophy has supplanted the long and widely held view expressed by Vannevar Bush, President Truman's science advisor, that "a sounder foundation for our national security rests in a broad dissemination of scientific knowledge upon which further advances can more readily be made than in a policy of restrictions which would impede our further advances in the hope that our potential enemies will not catch up with us."

The second asserted justification for restrictive information controls is that the federal government must curtail its deficit spending and excessive regulation. The policies that result, however—including the FCC decision not to publish the complete text of its proposed rules—limit access to much information about government decision making.

The negative effects of these policies could be substantial. As a 1982 report by the National Academy of Sciences (NAS) concluded, the continued health of U.S. science requires open exchanges among re-

searchers worldwide. The Soviet Union's experience illustrates the danger of a restrictive information policy. The American Physical Society cites official controls on scientific communication as the cause of the well-known Soviet lags in solid-state electronics and biology.

Restraints on the flow of scientific information can also hurt the U.S. economy. An April 1987 NAS report indicates that controls on the export of manufactured goods and information cost the U.S. economy 188,000 jobs and \$9 billion a year. Exporters report sales losses to Japan and other nations because of these controls. And limits on the participation of foreign citizens in the U.S. economy deprive the nation of needed foreign expertise. For example, 40 percent of all doctoral engineers entering the work force every year are foreign citizens.

A further victim of controls, ironically, is likely to be U.S. security itself, as the long-term technological progress on which it depends is impeded. Finally, if these trends persist, they will erode a long national tradition of free speech and public access to information.

The U.S. Tradition of Openness

The pattern of government information controls is one of historical shifts between openness and secrecy. The U.S. tradition of open communication stems from the Constitution, which guarantees freedom of speech, thought, religion, and the press. It also obliges the federal government to publish regularly information on its spending and taxing activities and their effects on the citizenry.

The late nineteenth century saw the beginnings of a long period of growth in the amount of economic and social data collected and circulated by government. During the first half of the twentieth century Congress repeatedly resisted efforts by the executive branch to impose official secrecy on the expanding number of federal agencies.

World War II ushered in an era of increased consciousness of national security and more restrictive information policies. President Roosevelt instituted procedures for classifying information in 1940, relying on a 1938 statute restricting public access to military installations, equipment, and "information relative thereto." World War II also prompted the founding of a large intelligence bureaucracy. After the war Congress gave agencies such as the Atomic Energy Commission and the Central Intelligence Agency authority to bar communication of some in-

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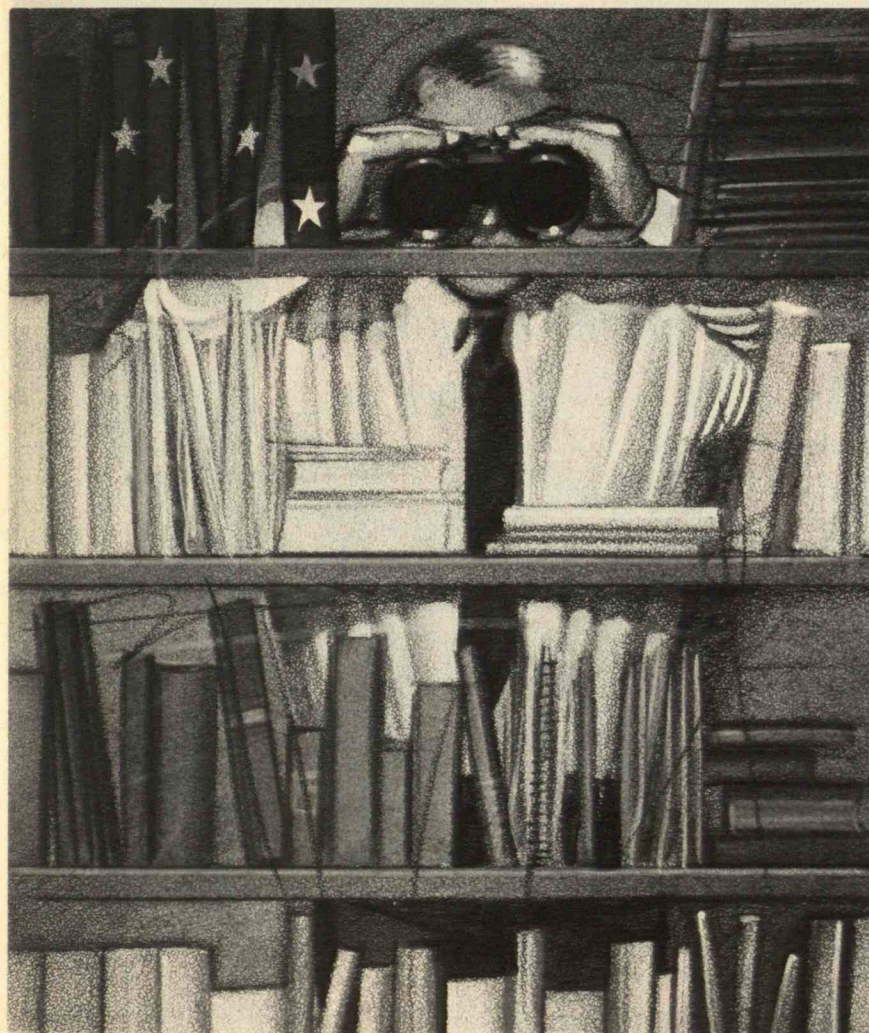
formation to protect national security.

A countertrend toward more open government began with enactment of the Freedom of Information Act (FOIA) in 1966. Congress strengthened the FOIA in 1974, and two years later passed the Government in the Sunshine Act requiring federal agencies to open more of their meetings to the public. During the 1970s the Ford and Carter administrations both issued executive orders designed to curb the excessive secrecy of intelligence agencies over the previous decade.

Presidents Nixon and Carter also narrowed the classification system. In a far-reaching 1978 executive order, President Carter stipulated that even if information fell into one of seven restricted categories, it was not to be classified unless its unauthorized disclosure reasonably could be expected to cause "identifiable damage" to the national security.

The order also called for documents to be automatically declassified after six years and prevented them from being reclassified. Significantly, information could not be restricted for the first time after an agency received a request for it under the Freedom of Information Act.

Meanwhile, demand for government information mushroomed with the expanding federal role in areas such as civil rights, environmental and consumer protection, public health and safety, and employment relations. This demand was spurred by a technological revolution that enabled both public and private sectors to store and disseminate growing amounts of information. But in the early 1980s, as demand for government-collected information continued to climb, the principles of public access again began to erode—this time to an unprecedented degree.



*The Reagan
administration
has made the
concept of
national security
virtually
all-encompassing.*

Expanding the Classification System

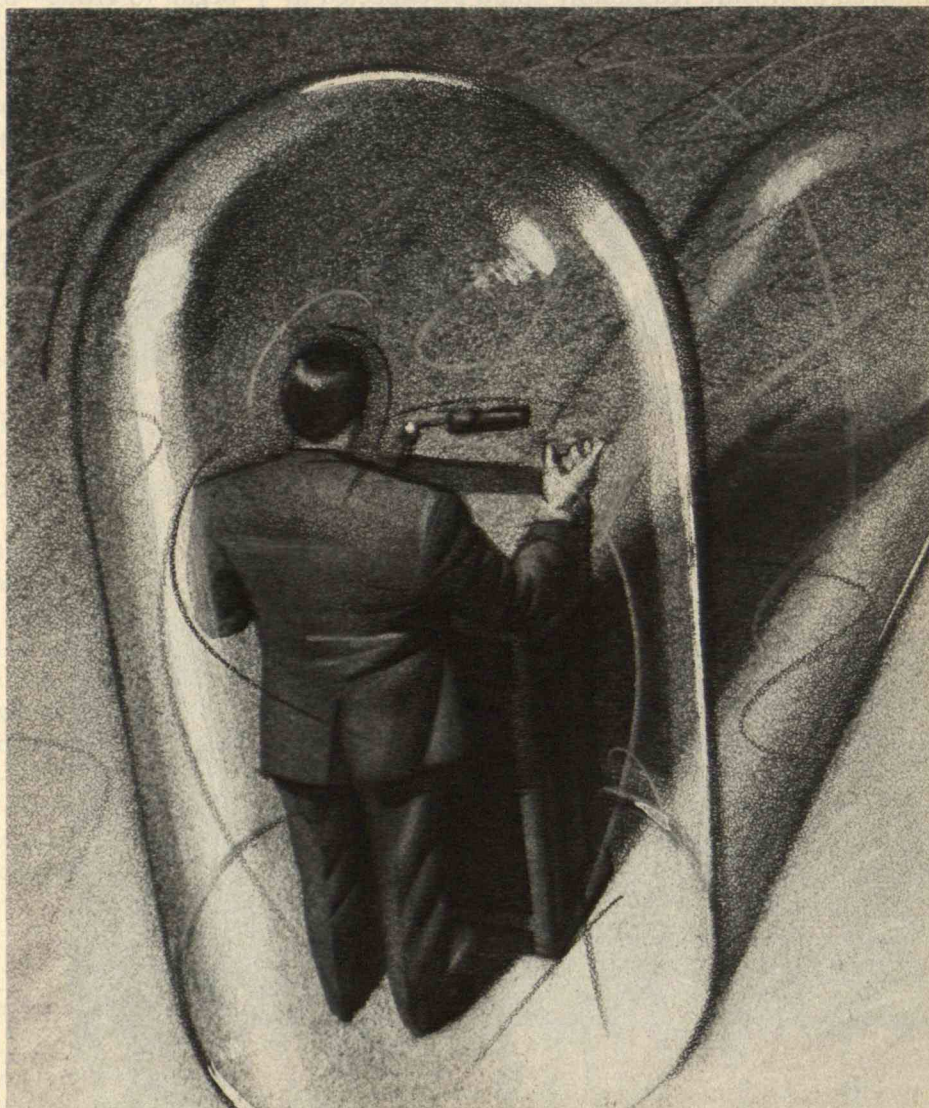
The Reagan administration has used a panoramic definition of national security to justify an extensive network of restrictions on many categories of government information. Richard V. Allen, former national security advisor to President Reagan, asserted in 1983 that national security "must include virtually every facet of international activity, including (but not limited to) foreign affairs, defense, intelligence, research and development policy, outer space, international economic and trade policy, and reaching deeply into the domains of the Departments of Commerce and Agriculture."

Supplementing this concept is the theory of an

"information mosaic": the idea that hostile elements can use sophisticated search techniques to assemble bits of seemingly harmless information into insights that threaten national security. An often-cited example of how this could be done is the blueprint for manufacturing an H-bomb published by *Progressive* magazine in 1979. The authors of the article amassed their information from unclassified data scattered through scientific journals.

Proponents of the mosaic theory have used it to fashion a broad expansion of the classification system. President Reagan issued a 1982 executive order giving federal officials authority to classify more information than ever before. Instead of having to demonstrate "identifiable damage" to national se-

The Reagan system appears to allow research to be classified at any stage and restrictions to be imposed indefinitely.



curity, today officials need only point out that "disclosure reasonably could be expected to cause damage to the national security." The order created a new presumption in favor of classification when officials are in doubt about whether secrecy is necessary. It also eliminated the requirement that information be declassified within a prescribed length of time, and gave officials new authority to classify documents already in the public domain.

The Reagan system appears to allow classification to occur at any stage of a project and to be maintained indefinitely. The net effect could be to inhibit researchers from making long-term intellectual investments in fields that are likely to be classified at a later date, such as cryptography and laser science.

Language from a research contract with the Department of Energy reflects this new policy: "If the grantee believes any information developed or acquired may be classifiable, the grantee shall . . . protect such information as if it were classified." This provision places the burden on researchers to determine what data to withhold, and does not specify how long they must comply. Such policies have prompted fears, in the words of one scholar, that "academic research not born classified may die classified." There is recent evidence that fears of retroactive classification are justified. In 1987 a federal appeals court upheld the National Security Agency's right to remove 33 documents from a library at the Virginia Military Institute.

New Use for Export Controls

The current administration has used the export-control laws to extend its sweeping view of national security. These laws—particularly the 1979 Export Administration Act—were enacted primarily to regulate the flow of goods and machinery. Yet they are increasingly being used to restrict the flow of intangible items such as unclassified technical information, both domestically and abroad. The asserted justification is that technical data are different from other information protected by the First Amendment because they can be used to create dangerous items such as weapons. And since technical information has immediate economic use, it resembles commodities more than ideas, according to this philosophy.

Such an outlook is new because there have traditionally been only two ways to restrict information. One is the classification system, for information controlled by government. The other is the doctrine of prior restraint, used for information not con-

trolled by government in extraordinary circumstances involving a clear and present danger to national security. The government's burden of proof in such situations is very heavy, as illustrated by its unsuccessful effort to enjoin the *New York Times* from publishing the Pentagon Papers.

The Department of Defense has cited the export-control laws in pressuring scientific societies to limit foreign access to DoD-sponsored research results—as evidenced by the restrictions on the 1985 meeting of the Photo-Optical Society.

When the presidents of 12 leading scientific organizations—including the American Association for the Advancement of Science and the American Chemical Society—protested these restrictions, the administration attempted to clarify the situation. The White House issued National Security Decision Directive (NSDD) 189, which exempts unclassified basic research from control—"except as provided in applicable U.S. statutes." But this did not assuage fears. One such statute, of course, is the Export Administration Act. DoD also issued a rule early in 1986 requiring scientists to submit all DoD-funded research for prior review "for consideration of national security at conferences and meetings."

Events at a June 1986 Linear Accelerator Conference, a biennial international gathering of nuclear physicists, revealed that not much had changed. The authors of 13 DoD-sponsored papers submitted them for clearance six weeks before the conference, as required. On the morning of the conference the Defense Department informed the authors for the first time that they could not present their papers—on the grounds that doing so would violate the export-control laws. Conference organizers appealed the decision, and after a hastily called meeting DoD officials cleared 10 of the papers—approving 1 only five minutes before it was delivered. One of the papers not approved had already been published.

To avoid such problems, some societies have informally barred foreign researchers from conferences. These include the Society of Manufacturing Engineers, the American Ceramics Society, and the Society for the Advancement of Material and Process Engineering. Nevertheless, restricted meetings are still more the exception than the rule. According to a 1986 survey by the American Association for the Advancement of Science, two-thirds of scientific so-

cieties with policies on foreign participation prohibit restricted meetings.

The Reagan administration's interpretation of the export-control laws has also forced scientists to be wary in their contacts with foreign citizens in classrooms, libraries, and research laboratories. The FBI's notice to librarians that they must report on "hostile intelligence people" is one such example. Another occurred in 1984, when DoD initially told UCLA's Extension Division that it could enroll only U.S. citizens in a course entitled "Metal Matrix Composites" because it involved unclassified technical data appearing on an export-control list. In 1981 the State Department attempted to require universities to report campus contacts between U.S. citizens and Chinese exchange students. Strong objections from universities led the department to abandon the policy.

The administration has also tried to restrict foreign nationals' use of U.S. scientific instruments. Supercomputers are a prominent example. The National Science Foundation (NSF) is the major funder of supercomputers at five universities, which will act as consortia for unclassified basic research. The Defense Department wants the universities to limit foreign scholars' access to these machines. Scientists have reacted with dismay, fearing that such restraints on unclassified work will undermine the quality of their research. Universities object to the prospect of policing researchers on campus.

The NSF has proposed guidelines designed to balance these concerns. Under the proposal, students from all countries could use supercomputers for regular course work. Soviet-bloc scientists could also use the machines for research in fields with no direct links to defense or intelligence functions. Officials from the departments of Defense and State as well as the White House have been reviewing the NSF proposals for more than two years without resolution.

The National Security Agency has designated some scientific fields as inherently sensitive and therefore subject to scrutiny under the export laws. A prominent example is cryptography, which has been so designated since 1981. Many cryptologists now submit their work to NSA for review before it is published to forestall even more stringent controls. The field of nuclear energy is also becoming increasingly secret. In 1981, at the request of the Reagan administration, Congress authorized the secretary of energy to regulate "the unauthorized dissemination of unclassified nuclear information."

By far the broadest category of information targeted for control is that maintained in electronic databases throughout academia, industry, and government. A National Security Council directive issued in October 1986 by John Poindexter, former national security advisor, laid out the policy. The directive sought to restrict unclassified information affecting not only national security but also "other government interests," including "government or government-derived economic, human, financial, industrial, agricultural, technological, and law enforcement information."

Poindexter's directive prompted fears that U.S. intelligence agencies would monitor virtually all computerized databases and information exchanges in the United States. The White House withdrew the notice in March 1987 under pressure from Congress, but the underlying policy—as set out in NSDD 145—is still in place. This calls for "a comprehensive and coordinated approach" to restricting foreign access to all telecommunications and automated information systems. The justification is again the mosaic theory—that "information, even if unclassified in isolation, often can reveal sensitive information when taken in the aggregate."

In December 1987, partially in response to the database controversy, Congress passed the Computer Security Act. This legislation transfers responsibility for developing a government-wide computer-security system from the National Security Agency to the National Bureau of Standards. But the act is silent on whether new categories of restricted information can be introduced as part of the security program.

Prepublication Reviews as Censorship

The federal government's funding of many information-producing activities puts it in a unique position to influence the content of research or restrict its publication. Recent developments show that such restraints can undermine the objectivity of research, and sometimes constitute official censorship.

A 1980 Supreme Court decision set the stage for allowing the government to examine a wide range of documents before they are published. In *Snepp v. United States* the Court accepted the government's argument that a former CIA agent's book violated his agreement to give the CIA a chance to determine

whether the material “would compromise classified information or sources.” This ruling led to CIA review of all proposed publications by current and former employees, not only those necessary to “protect intelligence sources and methods from unauthorized disclosure.”

Three years after the Snepp decision, the White House issued NSDD 84 requiring 120,000 federal employees and contractors to agree to lifetime reviews of anything they wished to publish. This directive also allowed the government to give employees polygraph tests while investigating unauthorized disclosures of classified information. The new policy further required agencies to set up regulations governing “contacts between media representatives and agency personnel, so as to reduce the

opportunity for negligent or deliberate disclosures.”

Testifying before Congress on NSDD 84, Thomas Ehrlich, then provost of the University of Pennsylvania, noted that prepublication review would discourage academics from serving in government, depriving the country of their expertise and insight. Ehrlich noted that the policy would also thwart criticism of government, since those “in the best position to provide that criticism”—academics who have served in Washington—would be enjoined from discussing their experience.

Under pressure from Congress, the administration suspended the prepublication-review provision in September 1984. However, it left in place a similar 1981 requirement that government employees with high-level security clearances sign a lifetime agree-



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ment—Form 4193—to submit all writings, including fiction, for prepublication review.

A 1986 General Accounting Office report concluded that suspension of the supposedly broader requirement has had little effect. The GAO found that the government had examined 21,718 books, articles, speeches, and other materials as part of the review process in 1984. In 1985, after the policy supposedly changed, the number grew to 22,820. By the end of 1985, at least 240,776 individuals had signed Form 4193. From 1984 through 1985, current or former government employees made only 15 unauthorized disclosures in their books, articles, and speeches.

Restrictions on publication can also be a source of conflict between the CIA and its civilian researchers, many of whom are academic scholars. Until recently, most CIA contracts required consultants and researchers to submit all their writings for prepublication review. Many universities chose to forgo such contracts rather than agree to the restrictions.

In 1986 the CIA narrowed prepublication review to “the specific subject area in which a scholar had access to classified information.” But the new rule continues to pose problems for scholars because they are likely to concentrate their research in their fields of specialization. Any later writing they do in those fields will apparently still be subject to CIA review.

Tension between funding agencies’ interest in obtaining a certain research product and scholars’ desire to avoid constraints are not uncommon, but this tension has risen to new levels. The conflict between Harvard and the Department of Housing and Urban Development, which wanted to review a scholar’s research results for six months before publication, is one example. Harvard also objected to a NASA policy requiring grantees to obtain the agency’s permission before copyrighting, publishing, or otherwise releasing computer software produced under contract. Harvard obtained an exception to this rule for one contract, but the underlying policy remains in place.

CIA contracts are a source of tension for scholars because the agency has traditionally required that the scholars not reveal that it funds their research. In 1986 the CIA recognized that a blanket rule would create “misunderstandings and suspicion,” so con-

tractors now can name their sponsor unless “public association of the CIA with a specific topic or subject would prove damaging to the United States.” But this exception seems to apply to a broad range of circumstances, including where “acknowledged CIA interest in its affairs” would “create difficulty with a foreign government,” or where “CIA interest in a specific subject . . . could affect the situation itself.” Such secrecy undermines the credibility of academic work.

Reducing Paperwork—and Influencing Policy

A pivotal point in the evolution of government information policy occurred in 1980 when Congress enacted the Paperwork Reduction Act (PRA). The current administration has used the act to cut back to a troubling degree the amount of information agencies collect and publish.

The Paperwork Reduction Act was a response to growing public concern about the burden of complying with federal requests for information, including tax and health-care forms and a wide variety of other required reports. The Commission on Federal Paperwork estimated in 1974 that these requirements cost citizens and government a total of \$100 billion a year. Yet as the Senate Committee on Governmental Affairs noted when approving the PRA, the government must collect information to fulfill important national goals, including promoting research, protecting civil rights, ensuring safe working conditions, and—above all—informing the public about the workings of government itself.

To streamline the process of collecting data, the PRA established an Office of Information and Regulatory Affairs (OIRA) within the Office of Management and Budget (OMB). The OIRA director is charged with determining whether the information a federal agency collects is “necessary for the proper performance of its functions,” including “whether the information will have practical utility.”

Concerned about potential abuse of these provisions, Congress explicitly stated that they do not authorize interference with “the substantive policies and programs of departments, agencies and offices.” Such interference, however, has become increasingly common.

An early example was a 1981 OMB directive requiring departments to cut the costs of producing both written and audiovisual materials. In response, the Department of Education created the Publications and Audiovisual Advisory Council (PAVAC),

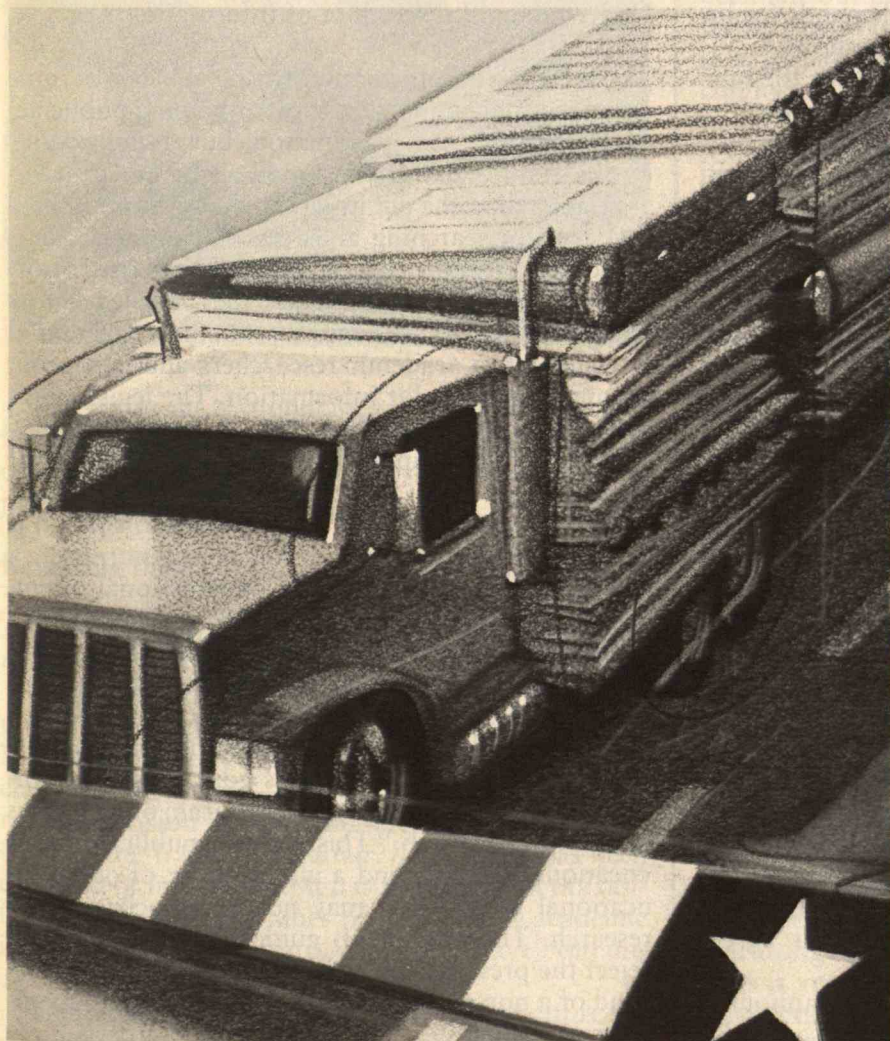
which rejected numerous requests from grantees to publish research results and information for the public. Yet as one research director pointed out, many contracts require grantees to publish the results of their work.

After examining the pattern of refusals, the House Committee on Government Operations concluded that the PAVAC review process was based on vague and content-related criteria—including whether the publication was “essential” or “timely”—that amounted to censorship. Moreover, the committee found that the review process had had no “cost-effective” results.

Since 1981 the administration has taken further steps to transform OIRA—and thus OMB—into a policymaking agency. The administration greatly expanded OIRA’s authority with a January 1985 executive order requiring agencies to submit their

regulatory plans to OIRA before making them public. OMB then reviews them for “consistency with the administration’s policies and priorities.” The agency has used this authority to interfere with efforts by the Department of Health and Human Services to require aspirin manufacturers to include warnings about the dangers of Reye syndrome on their labels. OMB has also hampered efforts by the Environmental Protection Agency to ban some uses of asbestos.

OMB has used the criteria of “necessity” and “public utility” in the Paperwork Reduction Act to decide which projects other agencies can fund. A prominent example has been research sponsored by the Centers for Disease Control (CDC)—which OMB must approve, under the PRA provision that it review plans by federal agencies to collect information from 10 or more people.



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A congressional committee asked researchers at the Harvard School of Public Health and New York's Mount Sinai School of Medicine to examine this process. After reviewing 51 projects CDC had submitted between 1984 and 1986, the study authors concluded that OMB was more likely to reject projects focusing on environmental or occupational health than those concerned with infectious diseases or other conventional illnesses. Research on reproductive topics, such as birth defects and venereal disease, was also more likely to be rejected. The authors noted that the proposed research had withstood the scrutiny of the peer-review process, and that OMB lacked the expertise to evaluate its practical utility. The authors concluded that the agency showed a "demonstrable bias" in thwarting efforts "to answer public demands for information on serious public health questions."

The administration has also tried to shift the burden of collecting and publishing information to the private sector. According to a 1985 OMB directive—Circular A-130—agencies must see that information is disseminated with "maximum feasible reliance on the private sector" and the use of charges to recover costs. This policy led in 1986 to efforts to scale down the National Technical Information Service (NTIS)—a clearinghouse for a wide range of scientific and technical data. The Commerce Department originally proposed discontinuing the NTIS entirely, selling it to the private sector, or contracting with a private entity for some or all of its functions.

This proposal prompted extensive criticism by legislators, libraries, universities, and industries that rely on the service, as well as by officials in the Public Health Service and the departments of Energy, Agriculture, and Defense. The Commerce Department's own staff concluded that "extensive privatization presents substantial costs and risks for the government, for NTIS customers and for the information industry as a whole." Critics worry that information without commercial appeal might go unpublished, and that private companies might be unwilling to maintain information over a long period of time. Changing the structure of NTIS could also hamper the influx of foreign technical information, which occurs through government-to-government agreements involving the NTIS.

The administration has responded by announcing—in a brief paragraph in the proposed 1988

budget—its decision to offer the private sector "the opportunity to operate NTIS on contract, with the government retaining overall policy direction." This has convinced neither the House nor the Senate. Both have voted in separate legislation to prohibit further privatization of NTIS without express congressional authorization. This prohibition has not yet received final approval.

Congressional dismay over OMB's attempts to manage information has also sparked efforts to cut OIRA's funding. This prompted OIRA director Wendy Gramm to set up a policy of disclosing OMB exchanges with other agencies regarding draft and final regulations. When Congress reauthorized the Paperwork Reduction Act in October 1986, it made this disclosure policy law and included a separate budget line for OIRA to allow close congressional oversight.

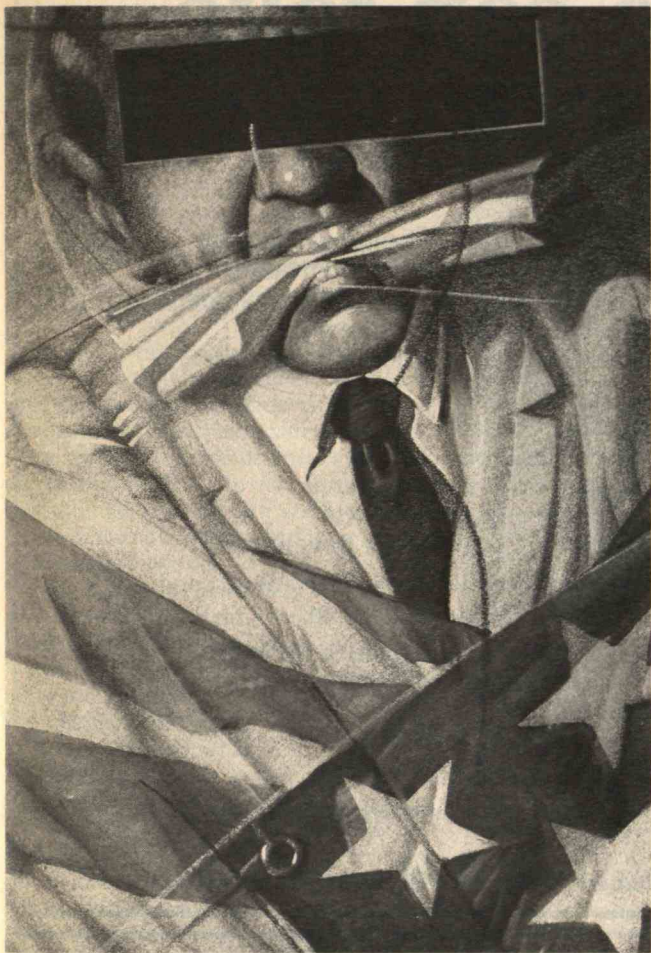
Undermining the Freedom of Information Act

The Freedom of Information Act (FOIA) has become an increasingly important tool for gaining public access to government information, but recent actions by the administration have made it harder to use.

In amending the act in 1986, Congress stipulated that fees for searching and reproducing documents could be waived or reduced when "disclosure of the information is in the public interest." The legislators recognized that exorbitant fees can be a substantial impediment to academic researchers and non-profit groups that apply for information. The legislation's sponsors further specified that "a request from a public interest group, non-profit organization, labor union, library or . . . individual may not be presumed to be for commercial use" unless the information is being sought solely for a profit-making purpose.

Despite these indications of congressional intent, the fee guidelines issued by OMB in March 1987 could significantly raise the cost of requesting information under the act. The new guidelines allow "educational institution(s)" to obtain documents for the cost of reproduction alone, excluding the first 100 pages. However, OMB defines educational institutions as entities that "operate a program or programs of scholarly research." This excludes public libraries, vocational schools, and a wide variety of other educational groups that may not be associated with research. The new OMB guidelines also expressly reject the presumption that a request "on the letterhead of a non-profit organization [is] for a noncommercial request."

The race to develop a high-temperature superconductor provides dramatic evidence of the advantages of open scientific communication.



The nonprofit National Security Archive has challenged these restrictions in federal district court. The case was argued in late January; a decision is still pending.

Reversing the Trend

A decade of restrictive information policies has significantly affected important aspects of national life. The United States has lost some of its ability to innovate in a world increasingly driven by technology. Excessive secrecy—partly the result of an expanded classification system—has led to compartmentalized federal decision making, manifested in its extreme form in the Iran-contra affair. The public has been deprived of information it has paid for with tax dollars, and important values of free speech, academic inquiry, and democratic participation have been undermined.

The recent race to develop a high-temperature superconductor, in contrast, provides dramatic evi-

dence of the advantages of open communication, especially in science. The two scientists who first succeeded in creating a relatively high-temperature superconductor were German and Swiss nationals working for IBM, an American company, in Zurich. Their research, funded by the U.S. Defense Department, set off a race around the world to develop practical ways of putting the discoveries to use. If federal policies had prevented these scientists from sharing their results, their work might still be unknown.

In mid-March 1987 thousands of physicists from around the world gathered in New York at a meeting of the American Physical Society to discuss the latest developments in this field. Such a meeting would not have been possible if DoD had prevented foreign nationals from attending.

Only one segment of the industrialized world has been left out in the cold during this extraordinarily fertile period of discovery and exchange. The Warsaw Pact nations have played no part in the superconductor frenzy. No one has sought to exclude them, but they are weighted down with bureaucratic restraints on travel, contacts with foreigners, and the use of telephones and copying machines.

Reversing the trend toward more government control of information should be a top priority of the next president. Within the first 100 days, the new administration should issue an executive order on information policy liberalizing the classification and export-control systems, and curtailing OMB's authority over the collection and dissemination of information. The president should also work with Congress to amend the export-control laws, the Paperwork Reduction Act, and the Freedom of Information Act.

The new executive order should establish a presumption that information generated both inside and outside the government will be freely available—except where it can demonstrate a substantial public need, such as a clearly defined threat to national security. The government should not restrict any information based on its speculative relationship with other data: the mosaic theory leaves no chance for practical limits on information controls.

In a democracy, the management of information and ideas must be guided by a heavy presumption that open communication is essential to society's well-being. Experience shows that the free flow of ideas is vital to the fabric of national life, powering the engines of innovation, guaranteeing national security, and protecting personal freedom. □

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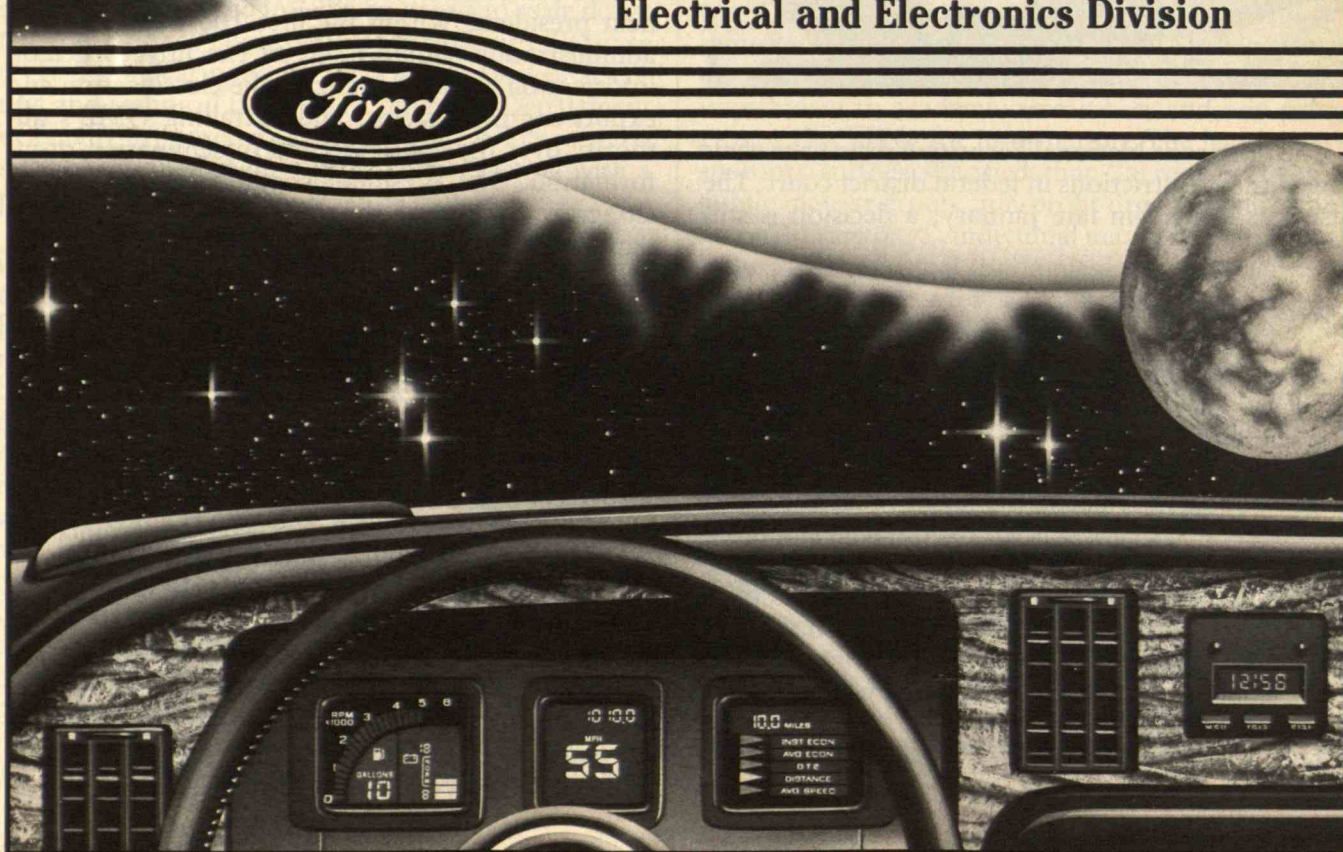
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Mideast Inventions, Scientists and Fraud

Amazing Technology of the Middle East

Islamic Technology

by Ahmad Y. al-Hassan

and Donald R. Hill

Cambridge University Press, \$39.50

Reviewed by Richard W. Bulliet

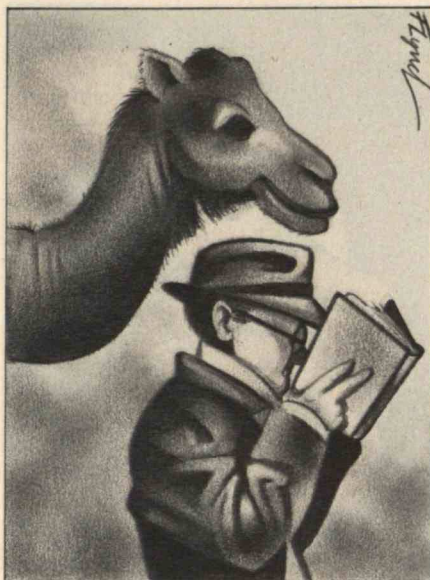
In medieval times, Islam was the beacon of technological achievement while Europe remained in the shadows. Yet Western historians have paid scant attention to the extraordinary inventiveness of the medieval Middle East. In *Islamic Technology*, Ahmad Y. al-Hassan and Donald R. Hill—well-known for translating Arabic technological works—attempt to rectify this situation by providing descriptions and illustrations of the remarkable technologies created while Europe slumbered.

Readers will be fascinated by the ingenuity of Muslim mechanical engineers, who perfected irrigation devices ranging from simple counterbalanced levers to a hidden water-driven wheel designed to look as though it was magically drawn by a wooden cow. These inventors also created both water-driven and mechanical clocks and made stabs at designing a perpetual-motion machine.

The medieval Muslims were ingenious at experimenting with chemical technology. They developed processes for distilling alcohol and perfumes and for manufacturing petroleum products, glass, ceramics, paper, dies, and inks. Indeed, Arabic printing (a technology not mentioned in this volume) preceded that in Europe by hundreds of years and may well have been its source. Muslims also developed leather products and silk, cotton, and linen textiles, and made important advances in agriculture and food production as well as in mining and metallurgy.

Al-Hassan and Hill even postulate that Muslims used cannons a century earlier than the Europeans, although many scholars would dispute their contention. None dispute the fact that Muslim armies deployed incendiary chemicals, called "Greek fire," as well as ingenious catapults and crossbows.

The authors cover some of these technologies better than others. They appear to be uncomfortable with artifacts, preferring instead to rely upon Arabic manuscripts and scholarly tomes on art history and archeology. Because they seem not to



have had much contact with the actual technologies they write about, the authors don't provide a thorough understanding of the techniques on which they are based. Nothing here compares to Hans Wulff's firsthand description—in *Traditional Crafts of Persia*—of the making of gold and silver thread, for example.

Part of the problem is that the subject is too vast for a single book. The authors recognize that a massive effort by many scholars, similar to Joseph Needham's *Science and Civilization in China*, would be necessary to do justice to their topic.

But curiously, they choose to define Islamic technology almost entirely in terms of Arab contributions during the medieval period, a point that Iranians and Turks will be sure to note. Many of the book's excellent illustrations come from Turkey, Pakistan, Iran, and other non-Arab lands, but the text scarcely mentions them. Al-Hassan and Hill include no mention of Indonesia and sub-Saharan Africa, which have substantial Muslim populations, and the authors treat the accomplishments of India's Muslims as part of a putative Indian technology rather than an Islamic one. Nor does their history extend to the early modern period, when Persian carpets and Ottoman tilework set the standard for the world.

The book's focus also raises the question of whether terming the technology of the medieval Middle East *Islamic* has any significance beyond fostering a sense of pride among today's Arabs and providing a counterpoint to Eurocentrism. Islam is

a religion, not one specific culture; no one has ever called the technology of Europe and North America Christian. Islam did exert a tremendous influence on the great medieval cities of the Middle East. Yet it's unclear why these cities grew in the eighth and ninth centuries to be many times larger than those of Europe. Was it because of economic changes provoked when the region was unified under the Islamic caliphate, or because people who converted to Islam migrated to the urban centers from which the Arabs chose to govern?

Whatever the reason, these cities provided the market and the concentration of capital, skills, and genius to make technology leap ahead. Moreover, the people who lived there, including non-Muslims, took it for granted that Islam was the fundamental force shaping their society. Regardless of whether this makes the technology that resulted Islamic, the religion was a vital component in the growth of one of the most creative and technologically skilled societies the world has ever known.

RICHARD W. BULLIET is professor at Columbia University's Middle East Institute and author of *The Camel and the Wheel* (Harvard University Press, 1975).

When Scientists Commit Fraud

False Prophets

by Alexander Kohn

Basil Blackwell, \$24.95

Reviewed by Joseph D. Robinson

That some politicians succumb to graft, some clergy are venal, some bankers embezzle, and some lawyers lie is obvious even to the most cursory reader of daily newspapers. Why then should we be surprised to learn that some scientists fudge data, or that not all scholars are selfless seekers after truth? And yet the idea that scientists or scholars, supposedly dedicated to the quest for knowledge and a better understanding of our world, should succumb to the lure of personal greed and glory seems especially appalling—even to the point of challenging the legitimacy of scientific inquiry itself.

However, it is crucial not to confuse the fraudulent practitioner with the common

A scientist who forges data
is akin to an embezzler who operates within sight
of a bank examiner.

endeavor, not to besmirch the quest of science with the faulty motivations of some scientists. Maintaining this distinction requires posing the following questions: What, if any, is the link between scientific error and fraud? What forms does fraud take? How widespread is it? And how can it best be curbed?

Alexander Kohn's *False Prophets: Fraud and Error in Science and Medicine* is the second recent book on these themes. Like its predecessor, William Broad and Nicholas Wade's *Betrayers of the Truth: Fraud and Deceit in the Halls of Science*, it provides a compilation of misdeeds in the guise of science. However, its scope is broader, including allied follies—literary and art forgery, faked biographies, malicious libels, and commercial dishonesty—as well as common mistakes and inaccuracies (of which it itself is a minor example, with many typographical errors).

As such, *False Prophets* is a readable compendium describing a diversity of misconduct. However, the slight titillation that comes with the unmasking of each particular fraud or error soon gives way to tedium under the repetitious weight of Kohn's catalog of examples. Moreover, the book's failure to address those four basic questions any serious reader wants answered dissipates the force of the author's moral fervor.

Forging, Trimming, and Cooking

First, what needs to be said about error, which Kohn in his subtitle links with fraud? Errors certainly do occur. Even the greatest scientists suffer occasional lapses. However, while scientists should strive to avoid error, formal procedures, no matter how elaborate, cannot guarantee error-free results. In fact, too drastic a fear of error can be paralyzing. For example, how far should the individual researcher go in search of statistical "significance"? A chance of error of less than five in a hundred? Less than one in a hundred? Less than one in a thousand?

Second, there is the matter of the forms of fraud. Distinguishing among these may be pertinent because some may be more frequent or more severe than others. Kohn quotes the 19th-century British mathematician Charles Babbage in differentiating among three categories of fraud: "forging" or inventing data, "trimming" or altering data, and "cooking" or selecting particular results for presentation or publication.



Forging and trimming are practices difficult for most people to understand. The motivation seems incomprehensible. One would think that, no matter how unscrupulously ambitious the individual, rational analysis would avert temptation since disclosure is almost certain and brings professional ruin. There must be intrinsic flaws in the psychology of the forger or trimmer, akin to the embezzler operating in sight of the bank examiner. In most cases, the experimenter must hope that the next try will provide the results he or she wanted in the first place, thus making it unnecessary to continue the fraud, just as the embezzler expects to replace the "borrowed" funds before the examiner arrives.

Kohn fails to provide any insight into this psychological dimension. He explains the most egregious forms of scientific fraud in terms of deadline pressures, funding requirements, and blind ambition. To the degree he mentions psychological factors, it is to suggest that science attracts a particular neurotic type, obsessed with recognition and success—not a very satisfactory explanation. Although Kohn does suggest that the forger or trimmer lacks a basic moral sense, he does not consider that a basic sense of self-preservation seems absent as well.

Babbage's third category of misconduct—"cooking" the data—is more complicated. Unlike forging and trimming, selecting data is probably not so rare. At times, it is acknowledged, and even when it is not it may still serve a useful scientific

purpose.

Consider the statement commonly made at scientific seminars, and received with knowing smiles, that the slide being projected "shows representative data." Rarely are such statements made after statistical evaluation; often the data shown are selected because they support the researcher's theory better than others. Selecting data to emphasize a point is tacitly recognized as a means of focusing on the results rather than on the experimental procedure itself.

Kohn cites a more complex example, the controversy surrounding American physicist Robert Millikan's measurement of the electron's charge. Millikan theorized that electrons existed and bore a specific electrical charge. He set out to measure the charge by means of his famous oil-drop experiments. As tiny droplets of oil fell between two charged plates, Millikan sprayed them with electrons, causing the drops to be attracted to the upper, positive plate. The rate of the rise from this attraction was then compared with the fall owing to gravity.

In a paper, Millikan reported his data as representing "all of the drops experimented on during 60 consecutive days." Later examination of his laboratory notebooks showed this not to be the case. His annotations of particular experiments include "Beauty. Publish this surely"—"Error high will not use"—"Very low. Something wrong"—"Exactly right." In his published paper, Millikan used only the values that supported his theory of a specific charge for the electron.

But this is not a simple story of scientific fraud, because it turns out that Millikan was right. Despite his selection of data, his idea of the electron was qualitatively accurate, and his estimate of its charge was extremely close to the accepted value today.

What moral can be drawn? Strictly speaking, Millikan was unethical in stating that he reported all data when this was not so. But there remains the problem for any experimenter of distinguishing between an experiment that he or she senses is working properly and one that isn't. Although Millikan's criteria were sometimes ambiguous, it is clear from his lab notebooks that he had good reasons for discarding particular experiments. To chalk this selectivity up to a fraudulent bias is far too simplistic.

What is needed, perhaps, is a better way to apply an experimenter's judgment of

what constitutes a good experiment, freed from the bias of the desired result. Statistical analysis is the standard method of doing so. Would a more statistically rigorous approach to Millikan's experiment have revealed the "right" answer and made the sin of suppressing certain findings unnecessary? One wishes that Kohn had addressed such difficult issues, rather than merely compiling cases neatly labeled "guilty" or "innocent."

Even when genuine scientific frauds occur, how serious are they? Answering this question requires knowing the frequency of fraud and devising a measure of how severely they mislead. Here Kohn is not at all helpful and engages in a fair amount of cooking himself. He cites a survey in which 194 of 201 questionnaires returned (out of how many sent and to whom?) reported knowledge of scientific cheating (of what sort?). But later in the book, he quotes congressional testimony of a noted scientist suggesting that deliberate falsification is, in fact, rare.

Such vague evidence doesn't even begin to shed light on the frequency or severity of fraud. What's more, Kohn says little about the effectiveness of detailed mechanisms—such as prescribed "good laboratory practice" and double-blind studies—that already exist to guard against abuses in scientific research.

The Uses of Scepticism

What should be done about scientific fraud? Kohn devotes the final few pages to some answers. Most are obvious, such as closer supervision of junior scientists and institutional protection for whistleblowers. Others seem impractical—such as insisting that every result by a particular scientist be repeated by a second researcher in the same laboratory.

Missing is the recognition that all such proposals also have their costs, in terms of bureaucratic regulation and supervision. And these must be weighed against the danger and costs of fraud itself. Before

we design new administrative mechanisms to combat fraud, the effects of current procedures need to be better understood.

Kohn quotes Jacob Bronowski that "the institution of science involves an implicit social contract" founded on the trustworthiness of individual scientists. But science is also characterized by healthy scepticism toward all received and reported values. The distinctive resource of science is the opportunity to confirm or refute results. This is an ever-present defense against the erroneous and the fraudulent.

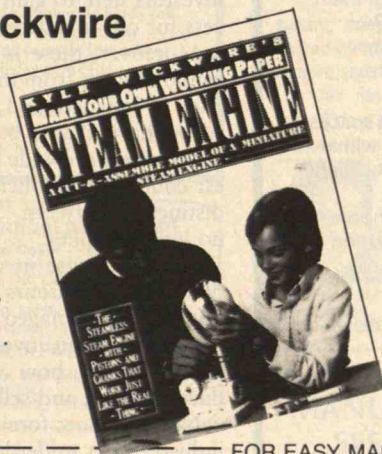
Kohn's list of culprits—whose misconduct, after all, was eventually found out—bears paradoxical witness to the effectiveness of this process. In this respect, the surest safeguard against scientific fraud may be the scientific method itself.

JOSEPH D. ROBINSON, M.D., is professor of pharmacology at the State University of New York Health Science Center in Syracuse and is active in biomedical research.

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Scandinavia	Airfare 2 Weeks, Hotel*	\$ 499	\$ 803
Tokyo	Airfare Only	\$ 627	\$ 851
Hong Kong	Airfare Only	\$ 660	\$ 850
Bahamas Cruise	5 Day Cruise*	\$ 385	\$ 585
Caribbean Cruise	Airfare 1 Week Cruise*	\$ 540	\$ 1040
Southern Caribbean Cruise	Airfare 1 Week Cruise*	\$ 874	\$ 1485
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Note: Each of these vacations departed from a Vacations To Go gateway city. Prices varied from city to city, but equivalent savings were available in all Vacations To Go cities nationwide.

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FORUM

CONTINUED FROM PAGE 25

So far foreign direct investment has been financed primarily by capital from other countries. But we can expect that with further weakening of the dollar, more financing will take place in the American market. And once the U.S. government stops borrowing as much money, investors worldwide will look for new outlets other than financing the American budget. Then we will see Japanese banks in New York attracting local deposits to lend to the U.S. subsidiaries of Japanese corporations. No doubt some people will feel that provides unfair competition in the loan market, but to economists the argument doesn't make any sense. Why should anyone care about the nationality of the lender?

Do Unto Others . . .

If we restrict foreign access to the United States, we may well hurt our own interests, present and future, in overseas markets. Our expanding service industry, for example, may find that its foreign investment opportunities will become limited. Consider foreign countries that allow our banks to operate there if we reciprocate by accepting theirs here. Indeed, we should use our leverage over potential foreign investors here to gain better and freer access for our investments abroad.

Moreover, there is no reason why we cannot benefit from the superior performance of Japanese and other foreign firms. All we have to do is buy their shares. Capital markets are wide open, with the largest companies publicly traded. The strict distinction between "theirs" and "ours" no longer applies.

The only sense in which we can think of some firms as ours is that they are predominantly managed by U.S. managers. But here foreign investment will help by demonstrating how we can better produce, market, and sell.

Not only does foreign investment bring industry into underdeveloped regions of the country, but it provides the potential for exports, which we are looking to expand as budget deficits are cut and therefore domestic demand declines. After another 20 percent depreciation in the value of the dollar, the United States may become a cheap-labor country. Foreign firms will want to establish facilities here to produce for their home markets. Foreign firms investing in the United States can help sustain employment at the highest possible wage levels and hence are more than welcome. □

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MITES: In collaboration with the Faculty Director, will manage and coordinate all aspects of the program, and actively participate in the admissions process. Will assist in recruitment and hiring of instructors and tutors, student and program evaluations, program final report, follow up on students and on-site counselling, all aspects of fund-raising. Oversee the scheduling of classes and the coordination of the many student services and activities.

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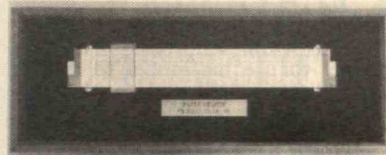
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Winning and Losing

Predicting Prisoners

How large must U.S. prisons be during the next half-century?

Arnold Barnett, a specialist in operations research in the Sloan School of Management, has now devised a model by which to predict future prison populations, and he has tested it on data for three states—Florida, Massachusetts, and Utah.

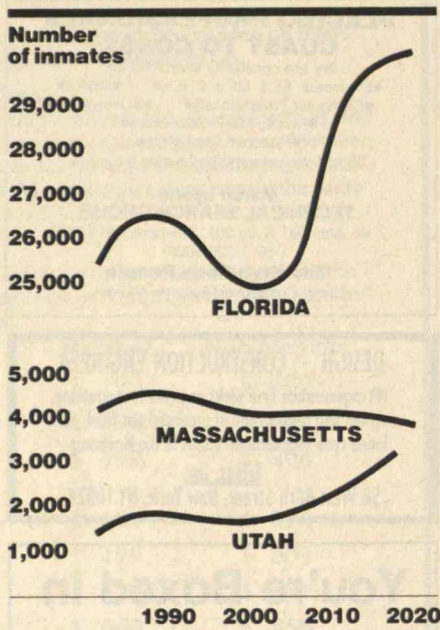
Given predicted economic conditions and a continuation of today's penal policies, prison populations will grow substantially in Utah and modestly in Florida by the year 2020; and they will decline slowly in Massachusetts. The growth in Utah is tied to rapid population increase and the loss in Massachusetts to decreasing population forecast by the Census Bureau. Florida will grow as fast as Utah, but "a disproportionate part of the growth is expected among older citizens who commit few crimes," explains Barnett.

The assumption that current trends will continue is a big one, Barnett admits, and he hopes to use his model to answer a series of "what if" questions. One of these—the only one yet reported in detail—is how tougher sentencing policies (longer sentences, but not more of them) would affect the number of prisoners. His result is a "surprisingly succinct" statement, says Barnett: "If x is the percentage increase in the mean time to be served, the percentage rise in inmate population is approximately $3x/5$." If longer sentences have a deterrent effect, the $3/5$ factor might be too high, but Barnett's analysis suggests no such result.

How We Lost in Semiconductors

Remember the efforts to stimulate innovation and entrepreneurship in the early 1980s—the tax subsidies for venture capital and the antitrust enforcement to prevent stuffy big companies from absorbing innovative little ones?

Hindsight tells Charles H. Ferguson of the M.I.T. Center for Technology, Policy, and Industrial Development that those policies may have been wrong. They did stimulate innovation, of course. But by encouraging the formation and independence of small companies they led in the long run to an "excessively fragmented, unstable, and parochial high-technology industry." In contrast, the Japanese semi-



The trend in prison populations in Florida, Massachusetts, and Utah in the next quarter-century, as forecast by Arnold Barnett of the Sloan School of Management. Massachusetts will fall and Utah rise because of changes in population; Florida's population will grow as fast as Utah's, but its growth will be chiefly in older people who tend not to be criminals.

conductor industry was "dominated by large, diversified firms"—just what was needed to compete in what suddenly became an exceedingly capital-intensive industry, Ferguson told the Senate Subcommittee on Technology and the Law last year.

There were other factors, too, in U.S. semiconductor losses, said Ferguson:

□ Insufficient capital and more expensive skilled labor in the United States, compared with Japan.

□ Too little federal concern for the long-term strength of high-technology industries. Ferguson believes mistakes were made or opportunities missed in many policy areas—educational loans, export controls, federal procurement, antitrust litigation. For example, he said, "whether or not the divestiture of AT&T was a good thing, the company's competitiveness in international markets should have been considered an extremely important element in the decision."

Shuttle Woes

Delays in the U.S. space program caused by postponed shuttle flights are starting to take a serious toll, says Gordon H. Pettengill, director of the Center for Space Research.

"There are beginning to be morale problems with the research staff," Pettengill told CBS Evening News early this year. "We aren't attracting graduate students as readily now as formerly: there aren't the missions to provide data for graduate theses."

One concern is that "by the time we get back into the game . . . the field will be covered by other countries' efforts. Indeed, because of our delays we are no longer considered a reliable partner in joint projects."

An example is the shuttle-launched Magellan Venus radar-mapping mission for which Pettengill is a principal investigator. It's now slated for an April 1989 launch, one year behind the pre-Challenger schedule, and on a trajectory that will take a full year longer to reach Venus—in total, a two-year delay. If the shuttle schedule slips further there will be even more waiting, more frustration, and more cost to keep the team together.

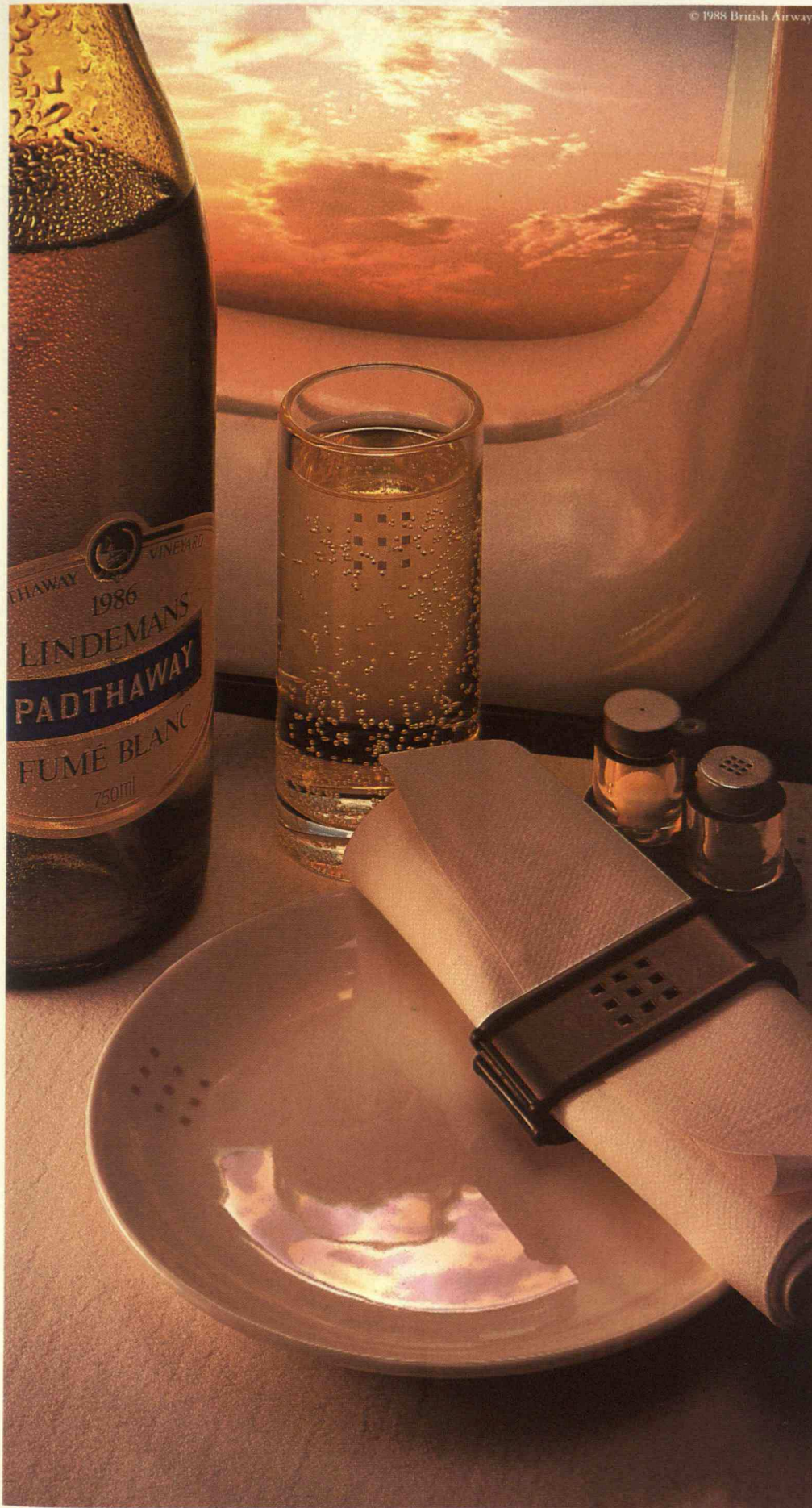
Report from the Summit

It was their openness and self-criticism that most impressed M.I.T. President Paul E. Gray about the Soviet delegates to what has been dubbed a "scientific summit" in Washington late last year. Gray was one of the 34 Americans at a National Academy of Sciences meeting with 11 Soviet leaders on the occasion of the Reagan-Gorbachev summit.

"The remarkable thing," he said upon returning from the meeting, "was the degree to which the Soviets were self-critical as they spoke about the ways in which the Soviet system until now has been unable to meet the needs of their society."

Gray was also impressed, he said, "by the enormity of the task these people are about. They are trying to recast a society and a structure that have been in place for 70 years. It is an unimaginably difficult task."

"But this was an impressive crowd," Gray told Charles H. Ball of the M.I.T. News Office. "Gorbachev travels with some pretty smart folks."



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